PRACTICAL BRICKLAYING

Grosvenor Atterbury, Architect.

Parrish Museum, Southampton, L. I.

PRACTICAL BRICKLAYING

A HANDBOOK OF INSTRUCTION AND MANUAL FOR THE JOURNEYMAN

BY

HOWARD L. BRIGGS, B.S., M.A.

Director of Vocational Education, Cleveland Public Schools

Revised and Enlarged

BY

WILLIAM CARVER

Architect, The Common Brick Manufacturers Association of America

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PREFACE

This book has no author. It is rather a compilation accomplished through the cooperative efforts of many. The compiler desires at this time to express his appreciation to those who have made this book possible.

Ralph P. Stoddard, secretary-manager of The Common Brick Manufacturers' Association of America, conceived the idea of preparing a practical textbook covering the bricklaying craft and it is due to his active efforts that its publication becomes a reality. William Carver, architect for the same association and author of "Brick—How to Build and Estimate" (freely quoted from in this book), has prepared illustrations, edited and revised the manuscript, written large portions of the subject matter, and in many other ways has been responsible for the preparation of the book in its present form. Andrew Pentland, a practical bricklayer and practicing contractor, has also been of inestimable assistance in correcting and completing the text covering the practical phases of the craft.

D. Knickerbacker Boyd, F.A.I.A., President of the Philadelphia Building Congress and vice-president of the American Construction Council, has placed upon the manuscript many detailed notes which have been included in the present edition. Thomas Preece, first vice-president of the International Bricklayers' Union, has likewise carefully scrutinized the typed manuscript and has approved it in its present form. Dr. George E. Myers, head of the division of vocational education of the University of Michigan, has made many suggestions relative to the organization of the material contained in the book from the standpoint of the expert in vocational education.

Robert A. Hart, instructor in the Bricklayers' Apprentice School of Cleveland, has assisted with valuable suggestions and criticisms. Those responsible for the production of the book

are indebted to the members of the Apprenticeship Committee of the Cleveland Bricklayers' School. This committee includes Messrs. George Dautel, Chairman, W. R. Carroll, Otto Best, W. K. Bell, L. E. Hoffman, E. F. Gibbons, Thomas Bolton, Morris Foley, and William Strain. Mrs. Briggs, an experienced teacher, is responsible for the compilation of the history of the craft and has been of constant assistance throughout the writing of the manuscript.

The W. Bingham Company of Cleveland generously furnished the illustrations of the tools used by bricklayers.

To all of the above, together with the many bricklayers upon the wall who have contributed information towards the compilation of this work, this book is dedicated with the hope that the combined efforts of all may assist in developing the bricklayer of tomorrow who will have that knowledge fundamental to pride of job and thoroughness in craftsmanship.

HOWARD L. BRIGGS.

CLEVELAND, OHIO.

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January 4, 1924

Mr. William Carver, Architect,
2121 Discount Building,
Cleveland, Ohio.

My Dear Mr. Carver:

I hope you will overlook the delay of my going over the manuscript of the text book. However, I got down to business this week and I have read over the manuscript with much interest and pleasure and I have no fault to find with it or criticism to make, as you will realize that I have examined the manuscript from the standpoint of a practical bricklayer and not from the architect or construction engineer's standpoint. I want to commend you gentlemen on the way in which the text book is written. It is written in the language of the mechanic. The title, names and phrases of the various materials, tools, and methods of using them are such that can be understood by every man familiar with the business, and as a bricklayer, I think of nothing that I can add to it that will improve it at all, but to the contrary, I feel if I meddled with it at all, I should only injure the work already done.

I have read three or four text books on Bricklaying and brick construction, some gotten up in this country and some in England, and I believe you have come closer to the subject and to the true meaning of the art of bricklaying than any of the others I have read. I feel confident this text book when printed will immediately get a wide circulation. As for myself I shall be glad to speak of it and commend it not only to our apprentices, but also to our journeymen, and I am pleased to endorse it as being the most useful book of information and instruction to put into the hands of both our apprentices and membership generally.

With best wishes for a successful year, I remain

Very truly yours,

Thos. R. Preece

TRP:C

First Vice-President.

PART I

PRACTICAL BRICKLAYING

HOW TO ESTABLISH A SCHOOL FOR BRICKLAYER APPRENTICES

By Ralph P. Stoddard

The abnormally great demand for all kinds of construction work immediately after the Great War brought to light a serious fault in the great building industry—that there was no definite system of obtaining workers and training them to become skilled craftsmen. And yet the whole industry of building construction is dependent upon its skilled men.

When it is considered that in the erection of even a small residence upwards of a dozen skilled trades are employed, and that to become a craftsmen in any one of these trades a long apprenticeship period is necessary, it is strange that the construction industry as a whole had not previously formulated and put into practice some comprehensive plan to supply and train a requisite proportion of the youth of the country as building craftsmen to replace those who drop out. There have been, of course, apprenticeship agreements between employers' and employees' organizations, but these agreements were very far from being positive schemes to insure that the demands of the present or future would be taken care of.

The Shortage of Craftsmen.—When the shortage of craftsmen began seriously to handicap building operations, various elements in the industry began to blame each other for the dilemma. It has been increasingly apparent, however, that the only way to meet the situation is to give constructive thought to the establishment of a system which will supply a sufficient number of journeymen to fill the ranks of those crafts which require thorough apprentice training.

The initiative in this movement to provide skilled men for construction has in a number of cases come from building

material producers, and it is natural that the trade association representing the manufacturers of building brick should have taken an active part in helping to build a practical system to provide thorough training for an adequate number of bricklayers to utilize the product of its industry.

The Cleveland School.—The inspiration for the national effort thus inaugurated by The Common Brick Manufacturers' Association of America was the success of the Cleveland Bricklayer Apprenticeship School. The Cleveland Mason Contractors' Association, affiliated with the Cleveland Building Trades Employers' Association and headed by George Dautel, its president, and Local No. 5 of Ohio of the B. M. and P. I. U., were together among the first to recognize the need and to set about devising a practical way to meet it. The Cleveland school was so successfully planned and conducted that it became a model; and the system of training which has now been adopted in many other cities is often referred to as the Cleveland system.

FIG. 1.—Bricklayer Apprentice Class. Salt Lake City.

In June, 1923, The Common Brick Manufacturers' Association invited representatives of various organizations interested

in the subject to meet in Cleveland for a visit to the school conducted there, and to devise ways in which to make this effort nation-wide. Various clay products associations, employers' associations (both local and national), national and local officers of the bricklayers' union, prominent architects, representatives of public school systems and of trade schools and of the Federal and State boards for vocational education attended the conference. At the close of its session, the following conclusions were reached:

FIG. 2.—Bricklayer Apprentice Class, Connecticut State Trade School.

1. That nothing the conference might do could immediately relieve the emergency caused by the shortage of bricklayers prevalent at the time in certain large building centers.

2. That the conference should concern itself with the establishing of a permanent national plan for the development of craftsmen in bricklaying.

3. That the most successful apprenticeship training is attained in schools conducted by boards of education with full cooperation of national and local employers' and employees' organizations, the pupils being apprentices regularly indentured to mason contractors, who are allowed

by their employers to spend some portion of their time (usually half a day per week) at the school, the employers paying them the usual hourly wage for the time so spent at the school.

4. That there is a place for the trade schools or other independent schools in the training of bricklayers.

5. That the bricklayer's union will accept any form of apprenticeship training which has the approval of the local joint arbitration boards, and that when bricklayers are in demand every man claiming to be a bricklayer is given an opportunity to demonstrate his ability on the job, and that such men will be admitted to the union if they prove to be skilled craftsmen capable of giving satisfaction to the employer.

6. That there is great value in human contact between the various elements in any construction operation, such elements including the craftsman, the contractor, the architect, and the engineer; and that it is well worth while to develop this human contact with the journeyman craftsman as well as with the apprentice.

As a development of these conclusions, it was proposed, first, that a complete textbook for the apprentice bricklayer should be prepared and published; second, that a national director of bricklaying apprenticeship schools should be engaged. The publication of this book is the carrying out of the first of these proposals.

It is the desire of the Cleveland Apprenticeship Committee, of the compilers of this book, and of The Common Brick Manufacturers' Association to aid as far as possible other communities in need of additional bricklayers, desiring to establish and carry on successfully a school fashioned after the Cleveland or a similar plan.

Federal Aid.—Under the provisions of the Smith-Hughes Act (the Federal Vocational Education Law) funds from the Federal treasury are available for promoting trade and industrial education. Parts of this fund are pro-rated to the states of the Union through the state boards for vocational education, for the purpose of maintaining all-day trade preparatory schools, part-time trade extension schools,

and evening trade extension schools. Approximately one-third of the funds available under the Smith-Hughes Act may be used only for part-time schools. This is the type of school promoted so successfully in Cleveland and the type recommended. The dispensing of the funds under the Smith-Hughes Act is controlled by the Federal board for vocational education, working through the state and city boards. Another branch of the Smith-Hughes fund may be used for the training of trade teachers, and this Federal aid also was employed in the Cleveland school.

Detailing in order the steps which should be taken in the establishing of an apprenticeship school, the first step should be a survey of local conditions, to determine whether there is actual need for a greater number of bricklayers in the community. In this connection it should be considered that at the peak of construction some shortage of craftsmen is inevitable. If there were skilled men enough to meet the demands at the most active period of the building season, then there would be unemployment at other seasons of the year. Whether or not more apprentices are needed, those who have already indentured themselves to employers should be afforded an opportunity for the thorough training which only a school can provide.

Next, a meeting should be called of the mason contractors' organization or other organizations of employers, of the representatives of the employees' organization, if one exists, and of a representative of the local board of education (usually the director of vocational education). The three elements in this meeting should be agreed that a bricklayer apprenticeship school is needed, and that each of the three interests will cooperate in establishing and conducting such a school. The board of education must first agree to establish such a school or schools in the city, providing supervision and instruction with the aid of Smith-Hughes funds and a suitable classroom. Employers through their association must recognize their responsibility to employ steadily to the fullest of their ability the boys enrolling for apprenticeship instruction. The bricklayers' organization must agree to give its cooperation to the

school and should indenture each boy to a contractor for the full period of his training.

As a third step, the local board of education must apply to the State board for vocational education for partial reimbursement for the salary of the instructor, by the State and Federal boards under the Smith-Hughes Act. This application should be made early in June in order that the State board for vocational education may appropriate funds in its budget for the coming year and secure the approval of the Federal board for the particular appropriation in question. In most communities the local school boards budget their expenditures annually and it is equally important that funds be set aside at a sufficiently early date to meet the local board's portion of the salary of the instructor and for the overhead costs in operating the school.

With these three moves consummated, a school may be established. The boys enrolled for instruction will work the full number of hours per week on the job, under the contractor to whom they are indentured. At least four hours each week will be spent in the schoolroom under the instructor. The boys are paid for the full week by their employers. The boys will receive the regular scale of apprenticeship wages, which, in Cleveland, is at present as follows: For the first six months, 32 per cent of the journeyman's wages; second six months, 36 per cent; third six months, 42 per cent; fourth six months, 48 per cent; fifth six months, 52 per cent; sixth six months, 62 per cent; seventh six months, 70 per cent; and eighth six months 80 per cent. The 4-hr. period in the school may be divided into periods covering both bricklaying practice and related subjects, including blueprint reading, trade estimating, materials, etc.

The teacher, unless he has previously had such training, should enroll in a teacher training class conducted under the direction of the State and Federal boards for vocational education. The instructor should be a practical bricklayer and care should be exercised in selecting a man who not only knows how to do the work but who also knows how to get along with boys and how to teach.

The Coordinator.—One very necessary matter is to devise some system to keep a constant check on the apprentices to see that they put in their full time on the job and at the school. The Cleveland committee has found it well worth while to employ an apprentice coordinator who puts in all of his time on this work, and whose salary is paid by the employers' association. Naturally this would not be feasible for smaller schools (the Cleveland school having a total of about 200 apprentices), but some continuous and positive check is necessary. When a boy fails to appear at the job or at school, his home is visited the same day and if a satisfactory excuse is not forthcoming, the boy must appear before the apprenticeship committee (which meets once every week for this purpose) for questioning and disciplinary measures, if necessary. This system has been found successful and has cut down nonexcusable absences almost to zero.

When the school is established, it is well to draw in as a cooperating unit the brick manufacturers and the material dealers who are interested in furthering brickwork. This fourth unit should give cooperation in supplying materials for use of the classes, and invariably the brick manufacturers have been found willing to donate the brick necessary for this purpose, while building supply dealers have donated mortar materials which are equally necessary for the work. It is recommended that the local architects also be made familiar with the work of the school, and that representatives of this profession be invited from time to time to visit the school and talk to the students, or that special evening meetings be arranged at which architects may give talks to the boys on plan reading, especially with a view of coordinating their work with the work of other trades as expressed on the blueprints. It is further recommended that the class of apprentices at least once during the period of their training should visit a brick plant, and witness each step in the process of manufacturing brick.

Attention is called to point 4 under the conclusions adopted at the Cleveland conference referred to above, which is as follows: "That there is a place in the training of bricklayers

for the trade school or other independent schools." Closely related to this is point 5, which resulted from statements made by authorized representatives of the International Bricklayers' Union, to the effect that the bricklayers' organization will accept any form of apprenticeship training which has the approval of the local joint arbitration boards, and that when bricklayers are in demand every man claiming to be a bricklayer is given an opportunity to demonstrate his ability on the job, and that such men will be admitted to the Union if they prove to be skillful craftsmen capable of giving satisfaction to the employer.

FIG. 3.—Making brick in Egypt.

It is not the purpose here to discourage trade schools or other types of schools which are successfully producing skilled craftsmen, even though the school is not conducted on the Cleveland plan. The local board of education is an agency available in every community, however, and the type of school which has the cooperation of the board of education, the employers, and the employees, is the one most heartily recommended.

THE HISTORY OF BRICKMAKING AND BRICKLAYING

The art of brickmaking has been practiced by all of the civilized nations of ancient times. The first brick of which we have any knowledge were composed of mud and straw and were dried in the sun. Sun-dried brick made by the Babylonians and the Egyptians some 4,000 years ago still exist in a perfect state of preservation. Egyptian tombs, dating back at least 6,000 years, are found to have been made of these crude brick. In a later period, according to tradition, brickmaking was the chief occupation of the Israelites during their bondage in Egypt. Mud from the banks of the Nile River, chopped straw or reeds, which acted as a binding material, and water in fixed proportions were thrown into a shallow pit. The mass was tramped upon until it was thoroughly kneaded and of the right degree of firmness. The mixture was then removed from the pit, shaped into brick, in molds or by hand, and dried in the sun.

At length it was discovered that in order to make brick capable of resisting extreme or continued dampness, more drying than that accomplished by the sun was necessary. The earliest fire-burned brick known are those found on the situations of the ancient cities of Babylonia and it seems likely that the art of burning blocks of clay to make permanent brick was discovered in this part of Asia. Egypt possessed stone quarries, a permanent source of building material. Babylonia, however, having neither stone nor wood was forced at an early date to make her own stable material for construction purposes. The high state of civilization reached by ancient Babylonia is still being revealed to us by the ruins of its great walls, towers, and palaces, all of which were made of brick. Often one of the flat surfaces of a brick was stamped with the name of the reigning king and, in building, this side of the brick was laid downward, being thus preserved, and giving us a dependable means of determining the dates of these ancient temples. The Babylonians and the Assyrians developed the art of brickmaking to a high degree, notably in the making of glazed or enameled brick, which they used for decorative purposes.

Less ancient but hardly less crude than the bricks made in Egypt and Babylonia are the "adobe" bricks found in Yucatan and in Mexico. Even in our own Southwest, in Texas, Arizona, New Mexico, and California, hundreds of these crude brick, or adobe, houses still exist, many of them having been in use almost constantly for 300 years.

The Greeks, having had a natural supply of stone and wood, found less use for brick than did the Babylonians and the Assyrians. It is certain, nevertheless, that crude brick

FIG. 4.—Brickmaking in India.

together with wood were in general use as construction material both for simple structures and for palaces before 1000 B.C. The Greeks used brick in the construction of the walls of many of their cities, because of its great strength in withstanding the shock of military attacks. Although the remains of Grecian brickwork are not as extensive as those left by the Romans, we have evidence that the Greeks were comparatively large users of brick.

The Romans, about the beginning of the Christian era, having the knowledge of the Babylonians, Assyrians, and Egyp-

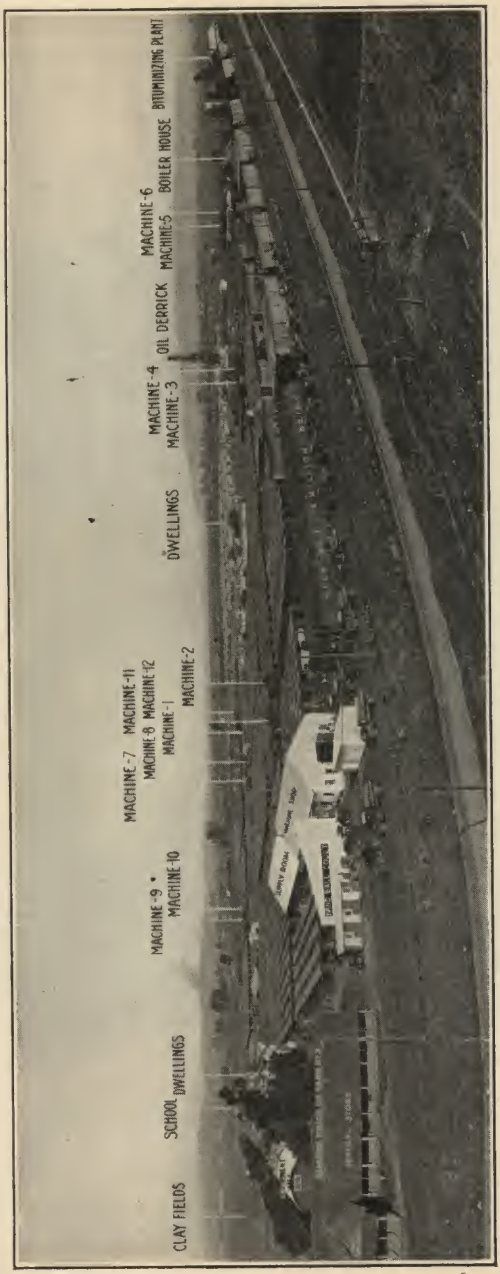


FIG. 5.—A modern brick plant in Los Angeles.

tians upon which to draw, restored to use and extended the manufacture of brick, taking great care in the choice and preparation of clay and employing the process of burning brick in kilns.

FIG. 6.—Long stretches of the Great Wall of China are of brick.

It was through the Romans that brickmaking was introduced into Britain nearly 2,000 years ago. The art was apparently lost, however, when the Romans withdrew from the country, and it was not restored to activity again until

about the thirteenth century. It was not until the fifteenth century that brick came into general use again, and in the reconstructing of London after the fire of 1666 brick were largely used. From that time until the present day, except in localities where building stone is more plentiful than good clay, brick have been used almost exclusively in all ordinary buildings throughout this country. At the present time some cities are classified as "brick cities" by insurance companies, who extend to them especially favorable insurance ratings.

Virginia seems to have been the first American colony in which brick were made. Here they were being made in 1611 and in Massachusetts in 1629. The first brick buildings in America were erected on Manhattan Island in 1633 by a Dutch governor. The brick used in these buildings were made in England and in Holland, both of whom furnished America with most of her brick for building purposes for many years. In the Colonies, burned brick were made first in 1650 at the New Haven Colony in what is now the state of Connecticut, and from there its manufacture gradually spread throughout the New England States. Brick was not manufactured in any great quantities, however, until after the American Revolution.

Excellent work had been done with brick in New England, Pennsylvania, and the South during the Colonial period; but until about 1880, brick were generally employed solely for ordinary construction, for backing walls and for residences and schools. About the last two decades of the nineteenth century, a revival of brick architecture began and an uncommon development in the manufacture and use of brick and terra cotta followed. Today, the United States employs a wider variety of types and colors of brick than any other country and no country has a more complete understanding of how to use this material to best advantage, both practically and artistically.

PART II

UNIT I

BRICK

1. Definition.—A brick is a solid building unit of burned clay. The temperature of the kiln in which brick are burned is at least 2,000° F. and the brick are exposed to this temperature for several days.

2. Size.—A brick is approximately 8 in. long, 3¾ in. wide, and 2¼ in. deep. These dimensions have been adopted as standard dimensions by the American Society for Testing Materials, The Common Brick Manufacturers' Association of America, and The American Face Brick Association. Another size for smooth-face brick (approximately 8 by 3⅞ by 2¼ in.) was adopted at a meeting recently called by the Simplification Division of the United States Department of Commerce. About 90 per cent of all brick now manufactured are of standard size, and this percentage is constantly increasing. The width of two brick, together with a mortar joint, will equal the length of one brick.

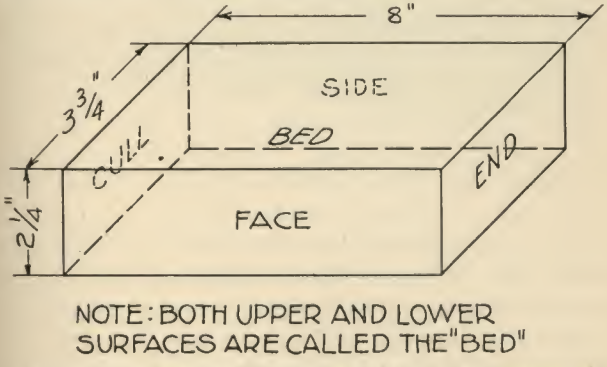


FIG. 7.—Approximate standard dimensions of brick, and names of various surfaces.

3. Names of Brick Surfaces.—Due to a lack of definite terminology in the trade, relative to the names of the surfaces

of a brick, it has been decided by a committee of The Common Brick Manufacturers' Association to designate the various surfaces by the names of side, face, cull, bed, and end, as shown in Fig. 7.

4. Common Brick.—Common brick is brick with a natural surface.

5. Face Brick.—Face brick has its exposed surfaces roughened or otherwise treated to produce special effects in texture or color. In many sections of the country brick for facing purposes are customarily selected from the harder burned common brick delivered to the job, or these are marketed in special selections by the manufacturers.

6. Pressed and Re-pressed Brick.—Pressed brick are made by two methods. Dry pressed brick are made by placing dry clay in molds under great pressure. The brick are then removed from the molds, placed in the kiln, and burned. Re-pressed brick are first pressed into molds a little larger than the brick will be when finished. After drying, they are pressed into smaller molds under very great pressure. Brick of this type are smooth upon all faces, usually accurate in measurement and edge. Due to their even surfaces, they may be laid with a very close joint. Both common and face brick are made by this process.

7. Soft Mud Molded Brick (Sand Molded and Water-struck).—Soft mud brick are molded by two methods. In the first method the clay is pressed into the molds after being mixed with water. The molds are then leveled off at the top. The mold is sanded before the clay is pressed into it in order that the brick may be drawn without sticking. These are called sand mold brick. If the mold is wet instead of sanded so that the brick may be drawn, they are called water-struck brick.

8. Stiff Mud Wire-cut Brick (End-cut and Side-cut).—Stiff mud brick are made from stiff clay which is forced through a die either of the width and length of the brick or of the width and thickness of the brick. The clay comes out in the form of a bar which is cut by wire cutters into bricks of uniform size. If the die is of the width and length of the brick, the wires cut the brick to the right thickness and they are called side-cut

brick. If the die is of the width and thickness of the brick, the wires cut them into end-cut brick.

9. Enameled Brick.—Enameled brick are face brick so treated that they have a glaze fused into the surface. They are produced in various colors and are easily cleaned. They are used for sanitary and decorative purposes. The standard size is 8 by 3⅞ by 2¾ in.

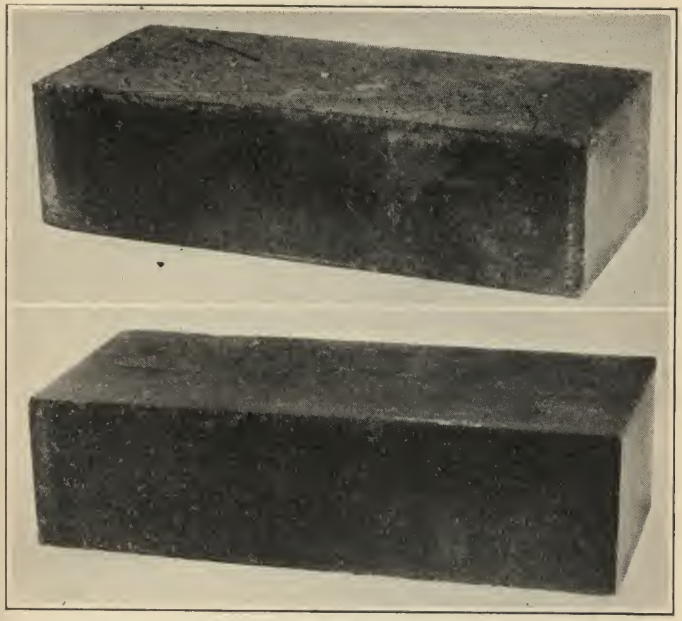


FIG. 8.—(Upper) Stiff mud side-cut brick. (Lower) Dry pressed brick.

10. Fire Brick.—Fire brick are made of a special clay called fire clay, and will withstand extreme heat. They are heavier and usually larger than common brick and are made for such uses as linings for furnaces. Silica brick are employed where resistance to strong acid gases and high temperatures are the requirements, the surface of the brick fusing and forming an impermeable face. Silica brick should not be used, however, where there is much fluctuation of temperature, as this tends to

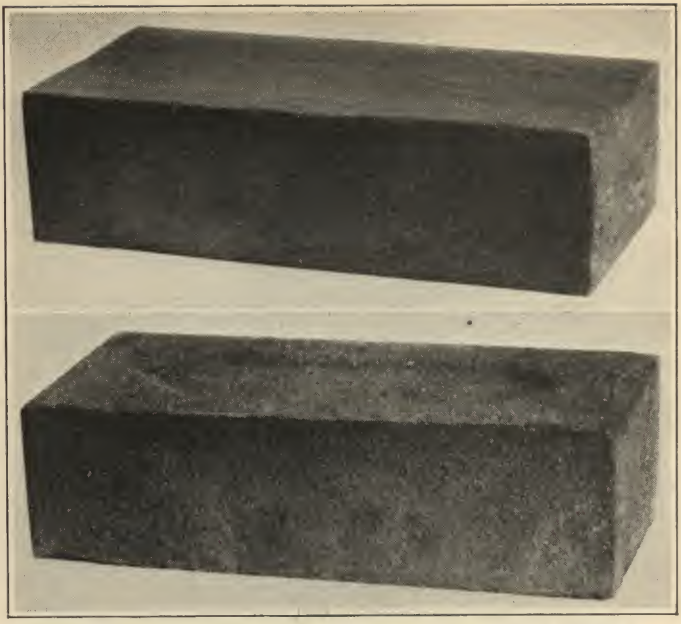


FIG. 9.—(Upper) End-cut stiff mud brick. (Lower) Soft mud brick.

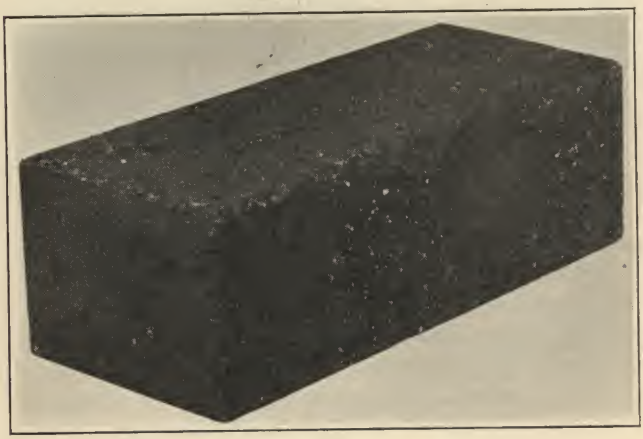


FIG. 10.—Plain wire-cut paving brick.

disrupt the brickwork. Where the furnace temperatures are alternately very hot and comparatively cool, fire brick should be used. The standard size for fire brick and silica brick is 9 by 4½ by 2½ in.

11. Paving Brick.—Paving brick are hard-burned and impervious. They are used where wear-resisting qualities are required for roads, walks, etc. Second quality pavers are sometimes used for building construction. They are larger than building brick, the four standard sizes being 3 by 4 by 8½, 3½ by 4 by 8½, 3 by 3½ by 8½, and 4 by 3½ by 8½ in.

12. Impervious Brick.—Any brick that is very dense in structure and will absorb little water, such as paving or hard-burned shale brick, is called impervious brick.

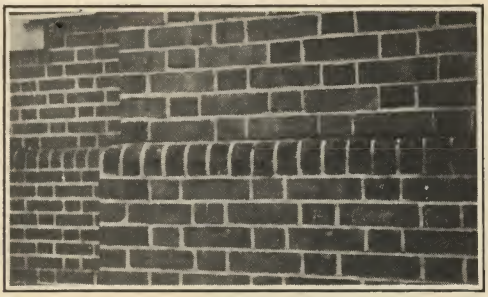


FIG. 11.—Illustrating the use of "bullnose" brick in a plinth.

13. Special Brick.—Special brick are made for particular purposes including decorative and unusual shapes such as for molded courses, arches, corners, chimneys, etc.

14. Porous Brick.—A very porous brick has recently been placed upon the market to be used for fireproofing steel structural shapes or for non-bearing partitions. In their manufacture, sawdust is mixed with the clay and burned out when the brick is fired. This makes a brick of very light weight and into which nails may be driven.

15. Selection of Brick.—Care in selecting the proper brick for each job will greatly influence the strength, appearance,

and cost of the finished work. Some of the brick in the kiln will always be fired more than others, causing a slight variation in dimensions. In many cases, some will come out hard-burned and others will come out underburned, or soft. Due to their color in red-burning sections of the country, soft-burned brick are sometimes called "salmon" brick. In selecting brick for facing the wall where they will be exposed to the chemical and physical action of rain and temperature, or for piers, walls, foundations subjected to heavy loads or dampness, or sewers, the hardest burned brick should be chosen. For backing up the inside of the wall and for party and division walls, the softer brick, if of a good quality, are satisfactory and are usually cheaper. When using only common brick upon a job, the manufacturer will sometimes deliver the hard-burned brick in separate loads. In some places the brick must be sorted upon the job, selecting the hard-burned brick for facing and making a separate pile of it. In many cases, the bricklayer takes the brick as it comes, but he should always lay the hardest brick to the weather. Architects will frequently specify that brick with the most "fire flash" be exposed on the face of the wall due to their artistic appearance as well as their hardness.

16. The names of the different classes of brick vary in various parts of the country and the bricklayer should learn the terms used where he is working.

17. The color and the texture of brick are a matter of selection. In work requiring special effects, face brick are sometimes selected for facing the wall. The mortar joint and the bond determine the character and appearance of the wall. Sample panels are frequently laid to enable the architect, owner, or builder to select a desired combination of brick, bond, and mortar.

18. As clays vary in given localities, the bricklayer will find wide disagreement in the brick in different sections of the country. Experience in each case is the only true method of determining the nature of the brick, as the color and texture are affected by the chemical and physical composition of the different clays to a marked extent and do not of necessity

indicate the nature of the brick itself. The best brick should not contain stones and should be reasonably free from laminations and cracks. The brick should be rough enough for mortar to stick to and neither too porous nor too impervious. Well-burned brick will give a clear ringing sound when clapped together and, if soft, will give a dull thump.

UNIT II

TILE, TERRA COTTA, AND OTHER PRODUCTS

1. Definition.—Tile and terra cotta are manufactured from the same type of raw material as brick and made by similar processes.

2. Hollow Tile.—Hollow tile, as the name implies, are hollow building units of burned clay constructed with a hollow core. They are used for partitions, furring, and, in cases where the load and their bearing capacity has been figured by a competent architect or structural engineer, for outside walls either faced with stucco or with brick tied to the tile by headers.

3. Hollow tile fireproofing for protecting structural steel columns or other similar structural menbers is commonly

FIG. 12.—Hollow tile protection on steel beam.

used. When the hollow tile is made from semi-fire clay, and the whole either tied with one No. 12 B. & S. gage wire tie placed tightly around each course, or by a strip of woven wire of $\frac{3}{8}$-in. mesh placed in each horizontal joint, the hollow-tile column covering is given a fire resistance period of one hour.

Hollow tile made from shale or surface clay should always be set 1 in. away from steel flanges and edges and filled solid with concrete between tile and column webs when used for this purpose, in addition to being tied with wire or mesh as before described. Unfilled tile of the latter kind is unsuitable for column protection; it readily cracks and spalls after a short fire exposure.[1]

4. Hollow Tile for Fireproof Floors.—Special hollow tile are made for fireproof systems. These tile are designed to span between I beams, and form either flat arches or segmental

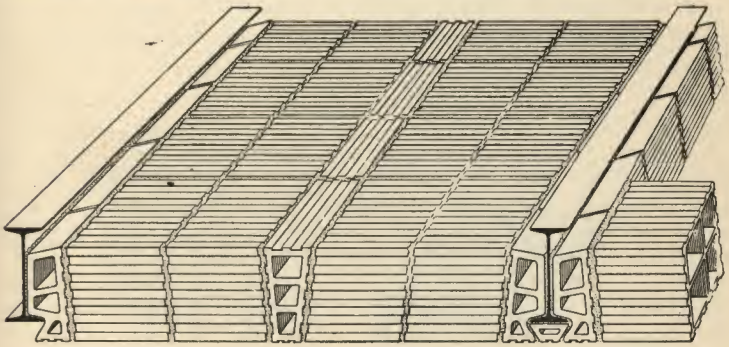


FIG. 13.—Standard flat arch combination. Side and end construction.

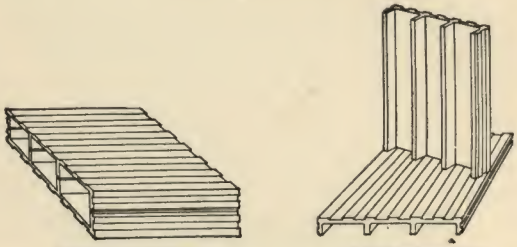
arches. Flat tile arches are adapted for spans from 3 to 10 ft. They are of either end or side construction. In flat arches of end construction the webs run at right angles to the supports. In flat arches of side construction the webs are parallel with the supports. An arch of combination end and side arch construction is here illustrated, and is considered the most desirable type (see Fig. 13).

5. Hollow tile 3 and 4 in. thick are made scored so they can split in half longitudinally and used as furring (see Fig. 14).

[1] The student who desires fuller information on this subject should send $2 for a copy of "Fire Tests of Building Columns," to The Underwriters' Laboratories, 207 E. Ohio Street, Chicago, Ill., which describes the results of fire tests made over a period of eight years by the U. S. Bureau of Standards, the Underwriters' Laboratories, and the Associated Factory Mutual Fire Insurance Companies.

6. Floor and Wall Tile.—Tile of a finer grade of clay are manufactured in various forms, sizes, shapes, finishes, and colors for surfacing walls and floors. They are durable, sanitary, and waterproof, and there is a large and attractive variety of effects which they may be laid to produce. Tile are also used singly or in panels as inserts to enrich the appearance of brickwork. The bricklayer will probably be called upon—and then only occasionally—to lay only the few types of tile mentioned here, inasmuch as tile setting is a separate craft.

7. Corrugated Paving Tile.—Corrugated paving tile are semi-vitreous, unglazed, dust-pressed paving tile $^{13}/_{16}$ in. thick and 6 in. square with a corrugated face.



Before separation After separation

FIG. 14.—Split furring tile.

8. Rough, Red, Paving Tile.—Rough, red, paving tile are semi-vitreous, unglazed, dust-pressed tiles $^1/_2$ in. thick (except 9- by 9-in. tile which are $^5/_8$ in. thick) in sizes 9 by 9, 9 by $4^1/_2$, 6 by 6 and 6 by 3 in.

9. Quarry, or Promenade, Tile.—Quarry, or promenade, tile is a term for machine-made unglazed tiles $^3/_4$ in. or more in thickness made from common clays. They are laid with a standard joint $^1/_2$ in. wide.

10. Roofing Tile.—Other types of tile are manufactured for roofing, being made in various shapes and colors from clay or shale. Burned-clay roofing tile are durable, fireproof, weatherproof, and artistic. They are brittle and must be fastened firmly so that they will not work loose in the wind and crack.

11. Ornamental Terra Cotta.—Ornamental terra cotta is made of burned clay of selected quality. While some standard sections are carried in stock, terra cotta is usually detailed and made specially for every job. It is used as a wall facing, for window sills, lintels, cornices, copings, etc. Terra cotta can be finished in any color or combination of colors and glazed to give any effect desired.

12. Terra cotta is manufactured as a shell about 1 in. in thickness (depending on the size of the piece) which is reinforced with webs. When placed in a brick wall, the spaces between the webs must be filled with brickwork, so that the proper thickness of wall and the proper wall line is maintained, and the terra cotta webs projecting into the brickwork firmly bond the terra cotta and brick together.

13. Concrete Blocks.—Concrete blocks are molded building units, made either solid or hollow of Portland cement and sand, and the bricklayer is sometimes called upon to lay them. They should be laid in cement mortar.

UNIT III

MORTAR

1. Definition.—Mortar is a mixture of lime, sand, and water; or of lime, sand, cement, and water; or of cement, sand, and water. Cement is most usually Portland cement. There is a variety of patent "brick mortars" on the market, the chief ingredient of which is generally natural cement or hydraulic lime.

2. Uses.—Mortar in horizontal joints provides an even bed for the courses above, and in all joints serves to unite the brickwork into one mass by its adhesive properties, and prevents the penetration of wind and weather between the brick units. It has an important bearing in the appearance of the completed wall, the mortar joint forming a large part of its area. The decorative effects of the various bonds are emphasized by the interlacing pattern of mortar joints between the brick units.

3. Selection.—The kind selected will depend upon several items. We must realize that the pay of the bricklayer forms a considerable part of the cost of masonry construction. It is therefore desirable to have a mortar easy to work with the trowel. We must consider the cost of the mortar, the weather conditions which it will be subjected to, and the load it must carry.

4. Setting.—Mortar is mixed by laborers, but the bricklayer should know how to proportion and mix it. The importance of selecting competent mortar mixers cannot be overemphasized. Good bricklaying depends upon good mortar. The lime or the cement, when it hardens or sets, binds the mortar together and to the masonry units with which it is in contact. The sand gives it body. There should be just enough lime or cement to fill all the spaces or voids between

the grains of sand in order that the mortar may have maximum strength. Setting of cement mortar is caused by the combining of the water with the cement, forming crystals which interlock and bind the whole together. If the mortar is disturbed while setting, these crystals are broken down and the mortar is weakened. For this reason mortar containing cement should not begin to set before the brick is in place. Lime mortar hardens by combining with carbon dioxide from the air, and the lime is converted back to calcium carbonate (limestone). Cement mortar will set under water, and obtains its maximum strength in about one year.

5. Consistency.—Under ordinary conditions mortar should be pasty enough to be easily worked with the trowel and to stick to the trowel and to the brick, but should not be so sticky that it will not easily "throw" from the trowel to the wall, leaving the trowel clean.

6. Mortar Bed; Mortar Box.—All mortar must be thoroughly mixed. For mixing, a mortar box should be provided. A lime mortar bed is sometimes used when lime mortar is to be stacked to season. This is made by spreading sand upon a platform of planks. A shallow place is scooped out in the sand, and into this the mortar is dumped. When colored mortar is used, a separate mortar box is desirable, or for small jobs a section of the large box may be boarded off. On large jobs money may be saved by using a small power-driven mortar mixer. A platform for storing lime mortar putty is also desirable.

7. Tools and Equipment.—A hose throwing a good stream of water, a barrel of water, a pail, a mortar hoe, and a square shovel are necessary.

8. Location of Mortar Bed.—The mortar box and platform should be located near enough to the building so that the mortar will not have to be carried far, but they should be distant enough to prevent splashing the building. The sand pile should be near the box where fresh loads of sand may be easily dumped.

9. Lime Mortar: *Nature.*—Lime mortar costs less than other mortars. It hardens slowly and its strength increases

with age. It loses strength with continuous excessive dampness and therefore should not be used for outside basement walls in continuously damp soil or for other damp places. When basement walls in damp places are thoroughly waterproofed, however, this objection would not hold.

10. *Use.*—Lime mortar is excellent for construction work above ground except in unusually exposed positions or in heavily loaded walls. It should not be used for walls with a large number of openings, leaving small piers to carry heavy loads. Straight lime mortar should not be used for fireplaces and flues.

11. *Slaking Lump Lime.*—Lime mortar should be made up in as large batches as is consistent with thorough mixing.

12. Lime is slaked by being placed in the mortar box and adding water. It becomes very hot, giving off vapor and bursting into powder, which reduces to a paste called lime putty.

13. Every lime requires slightly different manipulation and the best results can be obtained by following manufacturer's or dealer's directions, in the absence of which these suggestions are made. Experienced labor should be used for this purpose.

14. The higher the percentage of calcium the more quickly the lime slakes and the more heat is generated. Calcium limes are known as quick-slaking limes. A magnesian or high-magnesian lime will slake more slowly, combine with less water, generate less heat, undergo less increase in volume, set more slowly, and shrink less than a high calcium lime. Magnesian limes are known as slow-slaking limes. High-calcium limes may slake in a few minutes; high-magnesian limes may take half an hour.

15. With quick-slaking lime always add lime to the water; with medium limes add water to the lime. Care must be taken with quick-slaking lime to have sufficient water in the box before the lime is shoveled in to prevent "burning" or overheating. Hoe thoroughly and quickly and add more water at the slightest appearance of escaping steam.

16. With slow-slaking limes the danger lies in putting on too much water. Moisten a slow lime at first, cautiously adding

more water as slaking proceeds. Do not hoe until slaking is practically complete. Use hot water in cold weather, or if this is not practicable keep the mortar box covered.

17. Burned lime is granular and non-plastic, and will not bind the sand together; "drowned" lime is lumpy and watery. Both are practically useless for making mortar.

18. The laborer should have a good supply of water. A barrel of water and a pail should be handy for quick action if the lime starts to burn.

19. As soon as the slaking process is complete, mix the sand with the paste and shovel it out on the wooden platform, to remain until it is tempered for use. Sometimes where a poorer grade of lime is used, there is a residue of impurities after the lime is slaked. In such cases slake the lime in a separate box, afterward screening it into the mortar box and mixing it with the sand. Such lime does not generally make so strong a mortar as that which leaves no residue. It is a cheaper grade and for that reason is used for much ordinary low cost work.

20. Lump lime should generally be slaked at least one week before being used. This is a safe rule to follow, although some limes can safely be used two or three days after slaking. At the time of slaking some of the lime particles may escape the slaking process. If the mortar is mixed and used too soon, these particles of free lime will afterwards take up water, causing the mortar to be crumbly and to "pop." Ageing lime paste enables it to carry more sand.

21. Most frequently hydrated lime is mixed directly with the sand. When so mixed, it does not trowel so easily as mortar made from lime putty. Hydrated lime does not require slaking.

22. Proportioning Lime Mortar.—There is no set rule regarding the proper proportion of sand to lime. If there is too much lime in the mortar, it sticks to the trowel. If there is too much sand, it is stiff and difficult to work. If the sand particles are very fine, more lime will be required. Experience is the best guide to the proper proportioning.

23. Preparing for Use.—When the sanded and stacked lump lime paste is required for mortar, it is shoveled back into the

mortar box and tempered by adding water and working it up to the right consistency referred to in the trade as being "fat" or "greasy," that is, until it is workable with the trowel. It should have body enough to stay on the trowel without running off but should be soft enough to throw easily from the trowel to the wall, leaving a clean trowel. It should be hoed from end to end of the box until the lime is thoroughly distributed throughout the mass. If lime is left in spots or small masses, the mortar will not be so strong or so efficient.

24. Portland Cement-lime Mortar: *Nature.*—Portland cement-lime mortar is sometimes called "compos." It is composed of Portland cement, lime, and sand. It naturally has greater strength and is more weather-resistive than lime mortar. It will set in damp places and will stand fairly high temperatures. It works as well under the trowel as lime mortar.

25. *Uses.*—This mortar is a good allround type of mortar, and is suitable for almost any use.

26. *Mixing Lime Putty.*—In mixing cement-lime mortar, the cement should be tempered into the sanded lime putty. Do not mix the cement until the lime and sand have aged. If hydrated lime is used, it should be mixed dry with the cement and sand by spreading thin layers of each material in the mortar box and thoroughly mixing them before the water is added. Hoe the mortar from end to end of the mortar box. It should be just fat enough for the hoe to come out clean.

27. *Retempering.*—It should be mixed in small batches and used at once, as it attains its initial set in a short time. If it is retempered, the same observations apply as in the case of cement mortar.

28. *Mixture.*—A good proportion is six parts of sand to one part of cement and one part of lime.

29. Portland Cement Mortar: *Nature.*—Portland cement mortar is the strongest mortar. Although cubes of cement mortar, test the highest in strength, the fact that it works short and is not as plastic as other mortars makes it difficult for the bricklayer thoroughly to bed the joints, sometimes resulting in a wall that is weaker than one laid in a more plastic mortar.

30. It is used for piers or walls which carry heavy loads, for wet or exposed situations, fire and party walls, work under water, brick footings, sills, chimney and parapet caps, free-standing chimneys above roofs, brick steps, cheek walls to steps, brick porch and terrace floors, and similar exposed locations, and for use in freezing weather.

31. Straight Portland cement mortar works "short" and much is wasted because it does not stick. This is especially true with soft, or porous, brick which absorb the moisture from the cement too quickly.

32. *Adding Lime Putty.*—By replacing approximately 10 per cent of the cement with an equal amount of hydrated lime, or an equal amount of lime paste, or "putty," the mortar, being more plastic, will more easily and thoroughly fill the joints, thus making a stronger job.

33. *Mixing.*—A good proportion is one part of Portland cement to three parts of clean sharp sand, replacing about 10 per cent of the weight of the cement with hydrated lime or an equal amount of lime putty. The sand and cement should be thoroughly mixed before adding the water. The lime putty should be added last. Hydrated lime is usually mixed dry with the cement and sand. If hydrated lime is soaked overnight before using, it will make an easier working mortar, although this practice is not advocated by the lime manufacturers.

34. *Retempering.*—Specifications usually require that cement mortar shall not be retempered after taking its initial set. When larger quantities of mortar are mixed than are required immediately, however, the usual custom is to retemper it, adding water to replace that which may have disappeared by evaporation.

35. Retempering makes cement mortar more plastic and delays the final set. It seriously decreases the strength of quick-setting cements, such as natural cement. Professor Ira O. Baker[1] states that natural cement may lose 30 to 40 per cent strength by retempering after standing 20 min. and 70 to 80 per cent after standing 1 hr.

[1] "Treatise on Masonry Construction," p. 100.

36. With a slower setting Portland cement, the loss of strength is probably not serious if the mortar is retempered immediately after the initial set. Tests mentioned by L. C. Sabin[1] show that retempering is not deleterious to the tensile strength of Portland cement mortar if it is retempered several times during the period in which it is standing. It should not be allowed to stand undisturbed for any length of time. The loss of strength is greater with fine sand than with coarse.

37. Retempered mortar shrinks more than ordinary mortar in setting and may cause small cracks to appear on the surface of the joints. Mortar insufficiently mixed may have its strength increased by retempering.

38. The safest procedure is not to use mortar which has taken its initial set, especially if made with natural cements and quick-setting varieties of Portland cement.

39. Lump Lime.—Lump lime is made from limestone burned or "calcined" in kilns. There are several grades of lime which may be fat or lean limes according to their increase in volume when slaked. Fat limes carry more sand, work more easily under the trowel, and are smoother to the touch than lean limes.

40. There are two grades of lime: *a.* Selected lime which is well burned and picked free from all foreign material; and *b.* Run-of-kiln which is well burned but is not free of foreign material. Old or air-slaked lime must not be used. It may be recognized by the amount of powdered lime and the soft crumbly nature of the lumps. Good lime should slake upon the addition of water into a soft smooth paste free from lumps and sediment. Lime slakes in the air and spoils, therefore it is advisable to slake it at once upon arrival at the job. Unslaked lime must be kept away from dampness and water. Fires have been caused by water reaching it when stored. If it is necessary to store it, select a dry, covered place and keep it in the barrels with the covers on. Lime is sometimes powdered before shipping and is known as pulverized, or ground, lime.

41. Hydrated Lime.—Hydrated lime is made by slaking lump lime at the plant and comes in the form of a fine dry

[1] "Cement and Concrete," p. 252.

powder. Its use saves time and the labor of slaking on the job and the space required for the seasoning of sanded lime paste. It must not be confused with pulverized lump lime.

42. Portland Cement.—Portland cement is composed of ingredients artificially and correctly proportioned, burned in a kiln, and ground into a fine powder. It sets rapidly and will harden in water.

43. Natural Cement.—While natural cement is used successfully by some contractors who carefully follow manufacturers' directions, it has several objectionable qualities. It is a variable product; and it sets so rapidly that it must always be retempered before placed in the wall. Bricklayers, in fact, prefer to use it when retempered, since this increases its plasticity, but at the same time seriously reduces its strength.

44. Natural cement is not as strong as Portland cement; 1:1 natural cement mortar having about the same strength at the end of one year as 1:3 Portland cement mortar.

45. Sand.—Sand should be "sharp," that is, it should have sharp angular particles and should be clean or free from loam, clay, vegetable matter, and stones. Sand may be tested by shaking it up with water in a bottle with the water level above the sand. If loam is present, it will settle on top of the sand. Wet sand squeezed in the hand should not bind together and it should not leave a slimy deposit on the hand. When rubbed on the palm of the hand, clean sand will have a gritty sound. Too much sand makes the mortar short and it will not hang to the trowel or to the brick. Too little sand makes the mortar sticky, hard to throw, and leaves a dirty trowel. Sand should be well screened to eliminate the larger stones. Pebbles in the mortar delay the bricklayer, for he has to remove them, one by one, with his trowel. Well-graded sand containing the fewest voids makes the strongest mortar. When screening sand, a long vertical screen of $\frac{3}{8}$-in. wire mesh is faster than one with square openings.

46. For joints $\frac{3}{4}$ in. or wider, it is necessary to add coarse sand or fine gravel, the size increasing with the size of the joint. This is required to make the mortar stiff enough so that reasonable progress can be made with the work.

47. Mortar Color.—Mortar color is a powder or a paste which will give mortar any color desired for blending or contrasting with the brick used. If the straight colors are not suitable, almost any color or shade may be made by blending two or more colors together. Crushed granite or colored stone and colored sands are used to a limited extent as mortar colors and these colors are absolutely permanent. Pure white joints may be obtained with white sand, ground limestone or marble. Artificial colors are almost always used. Care must be taken to select colors of good quality. Poor colors fade quickly. Mineral colors are best, although in time strong sunlight will fade any artificial color. Paste colors are easier to mix but do not color as much mortar per pound as dry colors and are therefore more expensive.

48. Always mix colored mortar to a stiff consistency. The more thoroughly colored mortar is mixed, the less color it will require to produce a given shade. Determining the exact quantity of color and the method of mixing are best arrived at by following the directions of the manufacturer. Dry colors will mix more quickly if soaked in water some time before using.

49. If the bricklayer runs out of regular mortar, it is more economical to have him use colored mortar for backing up the wall until his supply of uncolored mortar is replaced. His time is worth more than the difference in cost of the mortars. If the wall is to be plastered directly on the brickwork or is to be stuccoed, this should never be done; the mortar color will work through and discolor the plaster or stucco surface.

50. Mortar color should not be mixed with hot lime as it will bleach out the color. Good color should neither seriously weaken nor affect the setting qualities of the mortar. Additional cement is sometimes added to the mortar to offset any weakening of the mortar, due to the addition of color.

51. Cold-weather Jobs.—It is not difficult to construct brickwork in cold weather if proper methods are followed. It is of the utmost importance that brick should be absolutely dry when laid. Cover the brick piles with tarpaulins when the brick are delivered. Bricks covered with ice will not bond with the mortar. Impervious brick are laid with more diffi-

culty in freezing weather than are non-impervious brick. Portland cement mortar is most frequently used in freezing weather. If it attains its initial set before freezing, it will continue to set even though frozen. Lime mortar sets too slowly. Natural cement is weakened by cold weather. It is considered good practice to add only just enough lime to make the mortar workable, for lime retards the setting of cement mortar and makes it much more susceptible to freezing before the initial set is attained. On the other hand, to raise its temperature, some contractors habitually mix a generous proportion of hot freshly slaked lime with cement mortar. On some winter jobs, the mortar is delivered to the bricklayers smoking hot from the addition of lime. Although this is not considered good practice, it has been followed on a number of large jobs and seems to work out satisfactorily. Salt lowers the freezing point of mortar and gives it more time to set, but as it absorbs water, it is likely to keep the wall damp. It also causes efflorescence due to the salt crystals forming on the face of the wall when the masonry dries out. If salt is used, however, not over a 5 per cent solution of salt should be added. Calcium chloride lowers the temperature more than salt and hastens the setting of the mortar. It also will cause efflorescence for the same reasons as given above.

52. On a small job in a moderate climate it may be possible to avoid the expense of special equipment. Manure may be spread on the soil around footings to prevent penetration of frost beneath them. Sand may be piled in a long high heap. The top and sides of the heap will freeze and sand for use can be tunnelled from the ends. The openings at the ends should be kept closed. Frozen sand must not, of course, be used for making mortar. Mortar should have attained its initial set before it freezes, although some contractors who have successfully carried on operations in freezing weather are satisfied if the mortar can be kept from freezing until placed in the wall. A "salamander," or a fire kept going near the box will help in preventing the mortar from freezing.

53. In severely cold weather, however, and on larger work the following methods may be followed and equipment used.

54. All materials, including brick, water, cement, and sand should be heated so that the mortar will be about 60° F. when brick are laid. Sand may be heated most conveniently by running horizontally through the material pile a corrugated sheet-metal culvert about 20 in. in diameter and 10 ft. long, or an old steel chimney stack or any other circular iron section, keeping a fire going at one end. Water may be heated in a coil attached to the water main with a fire in the center or in an iron can placed over a fire. Water should not be allowed to get much hotter than 165° F. or it will injure the mortar. If water boils, cool it with cold water.

55. It is highly desirable that methods be provided by which the bricklayer may have more year-round employment. Building in the past has been limited largely to definite seasons of the year. Happily, the present tendency is to do more winter construction. Scaffolds enclosed in tarpaulins and heating units known as salamanders in which coke is burned have aided greatly in carrying on cold-weather work.

UNIT IV

TOOLS AND EQUIPMENT

1. The Trowel.—The trowel is the most important of all the tools used by the bricklayer. It usually consists of a triangular shaped flat piece of steel with a wooden handle projecting from one end.

2. *Use.*—It is used for picking up mortar from the mortar board, for throwing the mortar on the wall, for spreading the mortar when necessary to make the proper bed for the brick, for tapping the brick down into its bed when necessary, and for clipping and cutting off brick. There are many special trowels, including those for "striking" the joints between the brick and for "pointing."

3. *Selection.*—There are many variations in the width, length, and weight of trowels and each bricklayer must select the one with which he can work to best advantage for each particular job.

4. Brick Trowel.—The brick trowel is used for regular bricklaying. It is the largest trowel and varies from 10 to

FIG. 15.—Brick trowel.

13 in. in length and from 5 to 8 in. in width. The Brades', or London, pattern is well tempered and balanced, and weighs from 1¼ to 1½ lbs. The short and wide trowel is considered by many to be the most efficient, as the weight of the mortar is nearer the wrist and does not tire the bricklayer or cause as much wrist trouble as if the trowel were longer and the weight

farther out. The Philadelphia pattern is of this type. Its heavier head makes it better for clipping and cutting bricks. The round-heel pattern is especially good for the latter purpose.

5. Buttering Trowel.—The buttering trowel is used to place or butter the mortar upon the bed and end of pressed brick that are to be laid with a buttered joint. The mortar is gathered upon the back of the trowel. A buttering trowel is frequently made of a cut-down brick trowel.

6. Pointing and Striking Trowels.—There are many styles of pointing and striking trowels varying from 4 to 7 in. in

FIG. 16.—Pointing trowel.

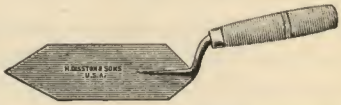


FIG. 17.—Another type of pointing trowel.

length and from 2 to 3 in. in width, which are used for various jobs where the large brick trowel would not be practical. Their main use is in pointing and striking up joints and for removing mortar from the face of the wall.

7. Fountain Trowels.—Several types of fountain trowels have been invented for the purpose of enabling the bricklayer to spread larger amounts of mortar each time he dips his trowel. These devices have not received the endorsement of the trade as a whole.

8. Bricklayer's Chisel.—A brick is of such a nature that it can only be cut by a hard blow. It is common practice to

FIG. 18.—Bricklayer's chisel or bolster.

use hard and rapid blows with the edge of a steel trowel for rough work but for finer work the brick-cutting chisel, or

"set" or "bolster," as it is usually called, is used together with a bricklayer's hammer. This is especially necessary in cases where a neat, accurate cut is desired. The chisels are made from 2½ to 4½ in. in width and the cutting end is ground to about 60 deg. with the straight side.

9. Bricklayer's Hammer.—The bricklayer's hammer has a flat head on one end and a chisel peen for cutting brick on the other. It weighs from 1 lb., 8 oz. to 3 lbs., 8 oz. For splitting and rough breaking, the square head should be used.

FIG. 19.—Bricklayer's hammer.

10. Scutch.—The scutch is similar to the bricklayer's hammer but has a chisel peen at both ends.

FIG. 20.—Brick chisel.

11. Brick Chisel.—The brick chisel is a steel chisel for cutting openings in the wall.

FIG. 21.—Star drill.

12. Star Drill.—The star drill is used for drilling small, round holes in the wall.

13. Jointer.—The jointer is used for making the various types of joints between the bricks upon the face of the wall. Such joints as the V, the concave, the beaded, the square, etc. require the use of this tool. They should have a hard temper, for the sand wears them out quickly.

FIG. 22.—Double brick jointer.

14. Tool Bag.—The tool bag is usually made of canvas and is useful for carrying tools from place to place.

15. Square.—The square is used to measure angles of 90 deg., or one-quarter of an entire circle. It is used for laying out corners and walls. The carpenter's steel square is frequently used for this purpose.

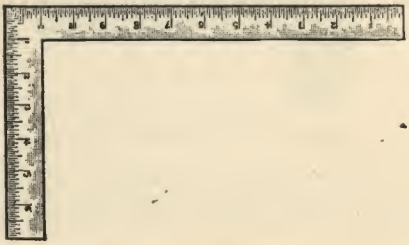


FIG. 23.—Steel square.

16. Pocket Rule.—The pocket rule is useful for various measurements on the wall, including distances between a number of courses in order to determine the correctness of the thickness of the mortar joints, the number of courses per given distance, the thickness of the wall, measuring closers, etc.

FIG. 24.—Plumb rule.

17. Plumb Rule: *With Plumb Bob.*—The plumb rule is used to keep the wall plumb. The older type consists of a

board cut true and square, about 4 ft. in length, 4 to 5 in. wide, and 1⅛ in. in thickness. There is a round hole bored through the flat side of the board several inches from the end. When this board is placed vertically against the wall, a lead weight suspended from the other end hangs in this hole. If the wall is plumb, or perpendicular, the plumb line will come along the exact center of the board. Under this condition the wall is plumb. This type of plumb rule is slower to use than the spirit level and a strong wind interferes with its satisfactory use.

18. Plumb Rule: *With Spirit Level.*—The modern form of plumb rule (Fig. 24) is made of hardwood and is called a spirit level. It contains two tubes of glass at right angles to each other, one in the side and one in the end. These tubes are nearly filled with a liquid, leaving only a small bubble of air in the tube. When the plumb rule is placed horizontally upon the wall and the bubble in the tube upon the side of the level is exactly in the center of the tube, the wall is level horizontally. When the level is placed vertically against the wall and the bubble in the tube in the end is in the exact center of the tube, the wall is plumb vertically. The average bricklayer's plumb rule is 4 ft. in length. Occasionally, small plumb rules are used for plumbing special jobs. Spirit levels should be constantly checked for accuracy.

19. Straightedge.—The straightedge is a piece of pine lumber from 5 to 16 ft. long, about 1⅛ in. thick, and from 6

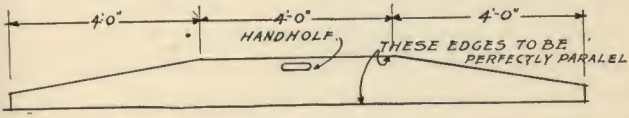


FIG. 25.—Detail of straightedge. Material—1⅛ in. × 6 in. white pine.

to 8 in. wide. Its long edges are true and parallel. By placing the ends of the straightedge upon two walls or piers to be lined up and the spirit level upon the straightedge, the accuracy of the levels of the two walls may be determined. It acts as an extension of the spirit level to cover distances longer than the length of the level.

20. Hod.—The hod is a V-shaped box with one end open and rounded and the other end closed, with a handle for carrying, and is used for mortar and brick. Hods are constructed of both wood and steel, the latter being the most durable. The hod carrier fills the mortar hod at the mortar bed, the hod being held upright by a support known as a mortar hod shank, raises it to his shoulder and carries it up the ladder or runway to the mortar board where he empties it from the open end. The mortar hod is approximately 24 by 12 by 12 in. The brick hod is approximately 21 by 7 by 7 in.

FIG. 26.—Mortar hod.

FIG. 27.—Brick hod.

21. Wheelbarrow.—Upon large jobs using a material joist and in any job where the mortar can be deposited upon the mortar board conveniently, the mortar is carried more economically in wheelbarrows. A steel wheelbarrow will last longer, because it will not warp from the moisture of the mortar. One should be selected which will enable a man to handle its load conveniently and quickly. Special designs are on the market for both mortar and brick barrows.

22. Mortar Board.—A mortar board is a surface constructed of square-edged boards 3 to 4 ft. square, cleated at the back to hold them together, and is placed upon the scaffold convenient to the bricklayer. It should be kept well filled by the hod carriers.

23. For laying pressed brick, a mortar board about 30 in. square is provided, standing on legs which bring the top of the board about 30 in. high.

24. Mortar Box.—Mortar boxes are used for mixing mortar. They vary in size according to the job. Some are built up and sent from job to job, others are in sections nailed together; and some are roughly constructed for each job. Metal mortar

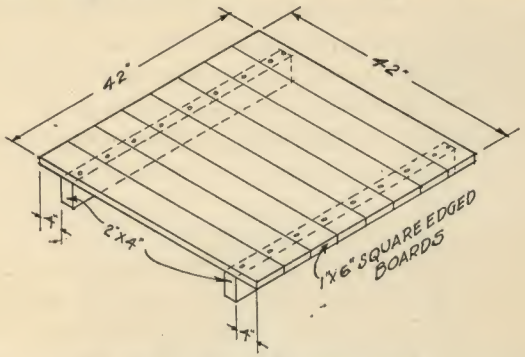


FIG. 28.—Detail of mortar board.

boxes are manufactured. The nearer waterproof they are the better, although the sand and mortar soon close up any cracks. The cubical contents of the box should be known in order to secure accurate mixtures. A box 5 ft. by 10 ft. by 10 in.

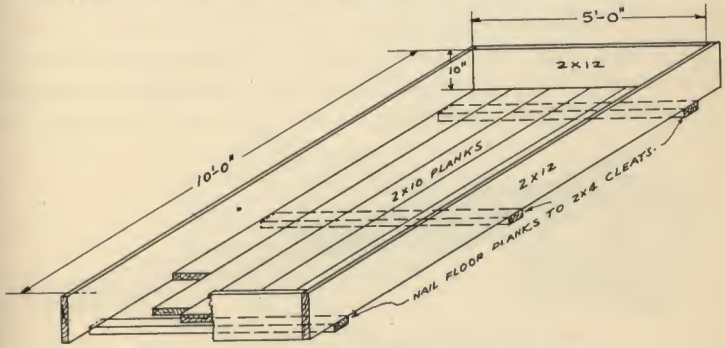


FIG. 29.—Mortar box. Capacity 1½ cu. yds.

high will hold approximately 1½ cu. yd. Its exact capacity when filled to the top is 41⅔ cu. ft.; or, in theory 1⅙ cu. ft. more than 1½ yd. A mortar box is seldom filled to capacity, however, and for all practical purposes the size given may be considered a 1½-yd. box.

25. Screen.—For rapid screening of the sand, a long, vertical opening which is narrow horizontally is the most efficient. The screen should be of the best quality and kept in good repair, as a few pebbles in the mortar will cause the bricklayer to lose much time. A $\frac{3}{8}$-in. wire mesh is satisfactory. Flat wire meshes sometimes permit the flat stones found in bank sand to sift through.

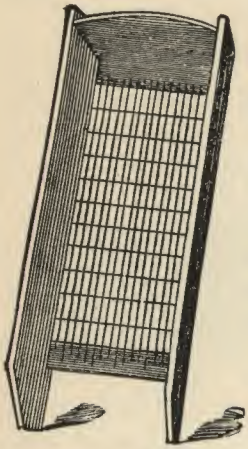


FIG. 30.—Sand screen.

26. Mortar Hoe.—Mortar hoes are necessary for mixing mortar and for tempering it. They frequently have two holes through the blade. The size and the weight of the hoe to be used will be determined by experience and the nature of the mortar being mixed.

27. Shovel.—The shovel should be square-pointed. The size and weight will be determined by the nature of the material to be handled. Too large a shovel is impractical.

28. Finger Protectors and Gloves.—Various forms of protectors for the hands are sometimes used. The constant working with rough brick sometimes wears the skin from fingers and thumbs until they are sensitive; and to work with sore hands is painful. This is particularly true when brick is being laid

FIG. 31.—Mortar hoe.

with shoved joints. Canvas finger stalls are sometimes used to protect the fingers. In extremely cold weather a special type of glove may be worn.

29. Line.—The "line" is a strong whip cord from 25 to 100 ft. long. The best quality should be used and for the

sake of efficiency and good workmanship a line should be discarded as soon as it becomes worn or brittle. Too thick a line should not be used if accurate work is desired. It is customary to keep each course of brick straight and plumb by the use of the line. In ordinary work the corners are carried up first and the line is stretched tight and plumb between them. The upper, outside edges of the outer tier at each course are carried exactly to the line but the line should not be crowded, that is, the edge of the brick should not force the line out of plumb.

FIG. 32.—A "trig."

30. Trig.—Long lines are frequently supported midway by a loose loop of string held by a brick resting on a second brick laid at the correct height in advance of the wall. This device is known as a "trig."

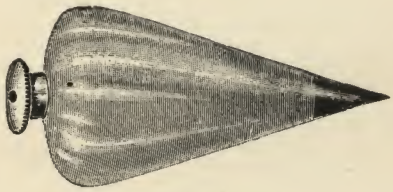


FIG. 33.—Plumb bob.

31. Plumb Bob.—The plumb bob is a pointed, metallic weight which may be attached to the line and suspended near a wall to determine its vertical plumbness.

32. Rod.—The rod is a piece of hard wood approximately $\frac{3}{8}$ by 2 in. and of varying lengths. It is used as a tool rest

when striking rodded joints or raised mortar joints, that is to say, joints which project a little beyond the face of the wall.

33. Scaffold: *Definition.*—A scaffold is the staging from which the bricklayer works after he has gone beyond the height he can reach by standing upon the floor or ground.

34. *Trestles.*—In buildings having bearing walls of masonry it is customary to build from the inside of the wall. The lower part of a basement wall in small buildings is often constructed from the excavation and the upper part from the grade level. As the joists are placed and the rough flooring laid as soon as the wall reaches a floor level, the brick-

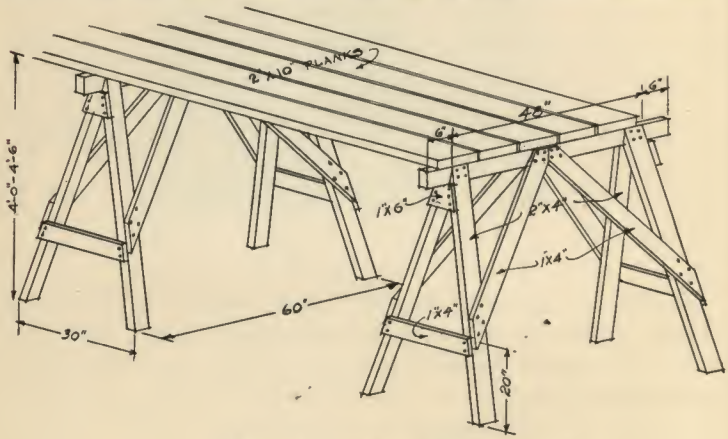


FIG. 34.—Detail of trestle.

layer may work from that floor up to a distance of approximately 4 to 5 ft. and may then carry the wall up to the next floor level by the use of trestles with two-by-ten scaffold planks placed upon them. Where no rough flooring is laid upon the joists, the trestles may be placed upon planks laid directly upon the joists.

35. Trestles are usually constructed of boards so braced that they form supporting units for the planks. Some are hinged at the top and braced by iron hooks or held by ropes in order that they may be more conveniently packed for delivery to the job. The trestle should be kept 2 to 3 in. from the wall in order that the freshly laid brick may not be

pushed out of line. The joists to be used on the floor above are sometimes used for scaffold planking.

36. *Scaffold Squares.*—Scaffold squares are portable supports for scaffold planks usually constructed of wood in the

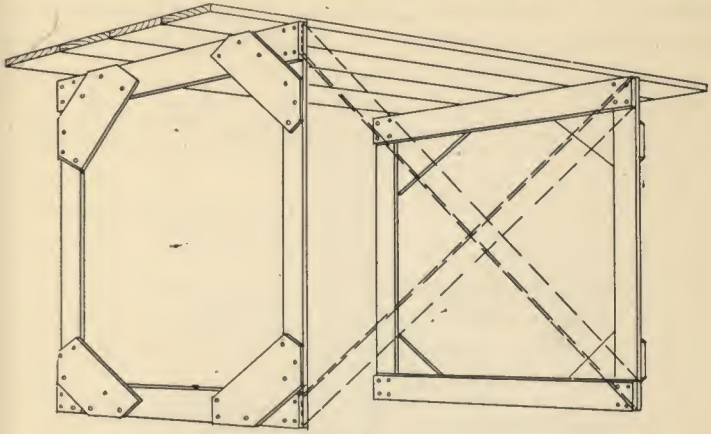


FIG. 35.—Scaffold squares.

FIG. 36.—Foot scaffold.

form of squares so that they may be erected at intervals perpendicular to the supporting ground or floor, parallel to each other, and braced by boards nailed to the upright members. Scaffold planks are then laid over their tops.

37. *Foot Scaffolds.*—Foot scaffolds are constructed of a plank raised above the regular scaffold on bricks to enable the bricklayer to reach a given height.

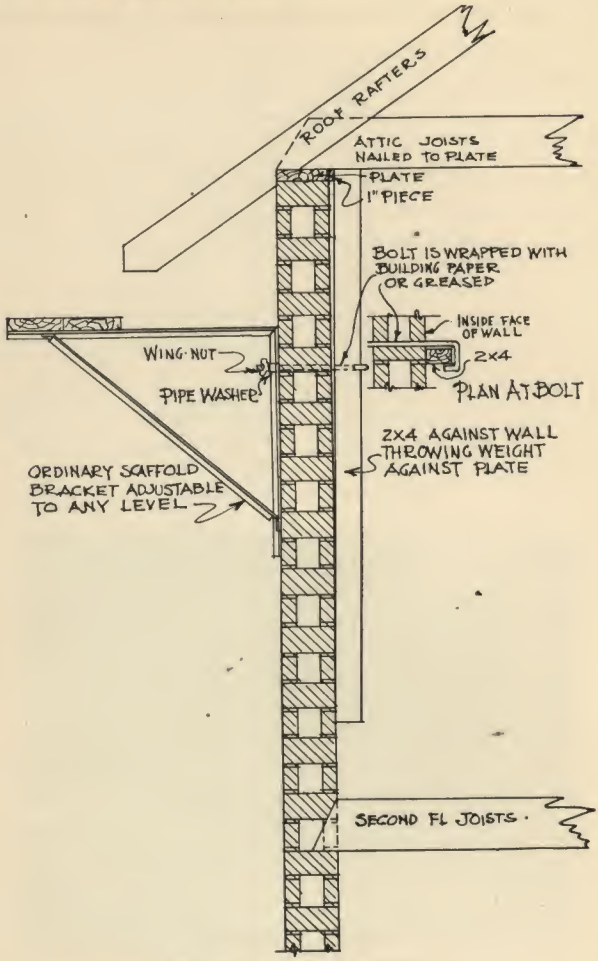


FIG. 37.—Scaffold brackets.

38. *Scaffold Brackets.*—Scaffold brackets on the outside of the wall are bolted through the wall to a two by four on the inside. They are used for supporting scaffolding on the out-

side of the walls of residences or other small buildings for building cornices, etc. (see Brick—How to Build and Estimate).

39. *Putlog Scaffold.*—A common form of scaffold used in cases where it is desirable or necessary to work from the ground up, on the outside of a building, is the putlog scaffold. It is usually constructed of rough timber. Three by fours or larger poles

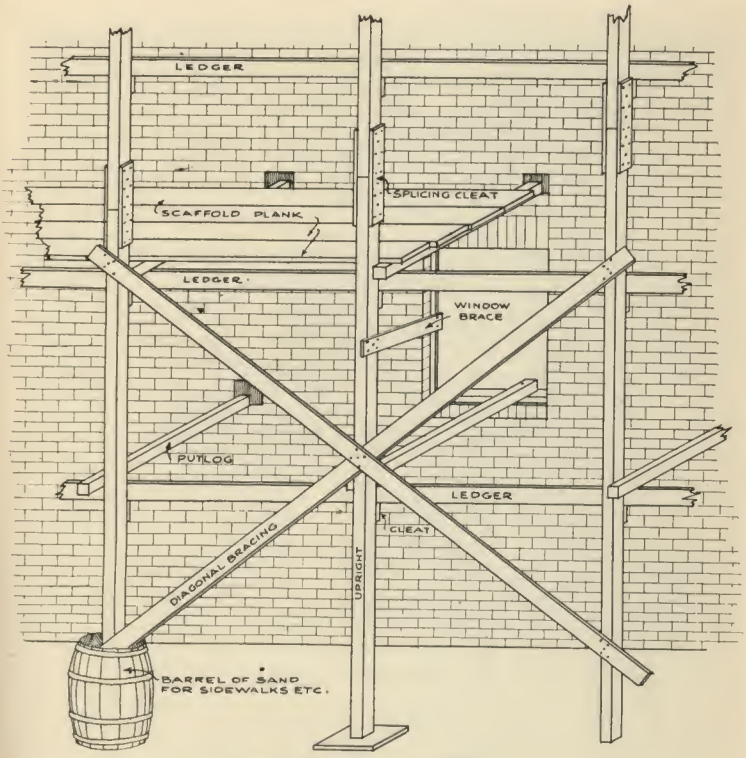
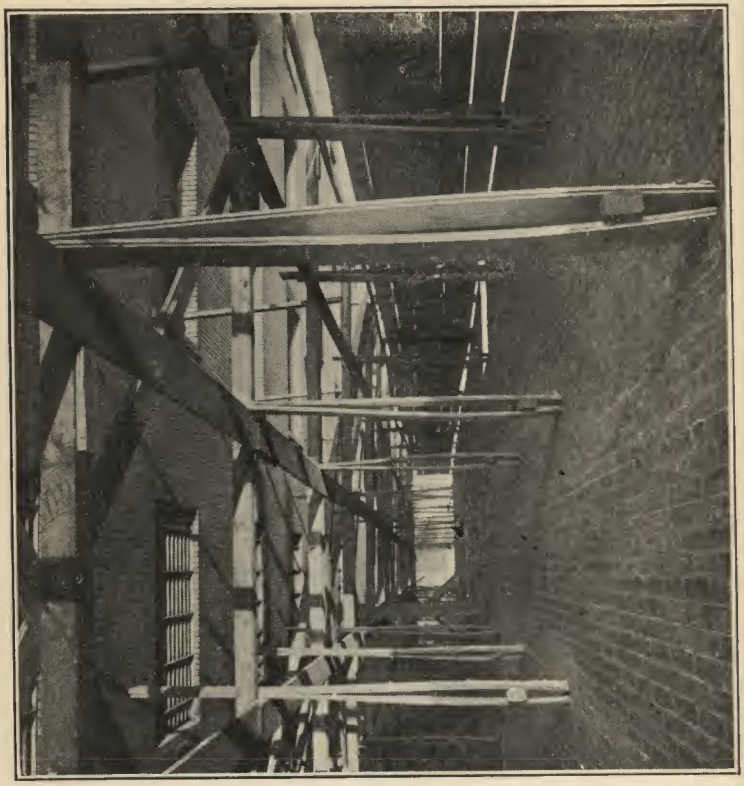


FIG. 38.—Putlog scaffold.

are erected vertically approximately 8 ft. apart and approximately 54 in. from the face of the wall. The poles should rest upon pieces of boards or planks to prevent settling into the ground. One-by-eight boards called "ledgers" are firmly nailed horizontally on the inside of the vertical poles. It is safer to nail a cleat to the pole just under the ledger.

40. *Putlog.*—A length of three-by-four pole known as a "putlog" rests on top of the one-by-eight horizontal ledger and against the three-by-four vertical pole. The other end rests in the face of the wall to a depth of one tier. On top of the putlogs, five two-by-two planks are laid, leaving a space of 2 in. between the planks and the wall.



(Courtesy Travelers' Insurance Co.)

FIG. 39.—Spring stays.

41. *Staying.*—The poles should be tied to the wall by "stays" through window or other openings. When this is impossible, "spring stays" should be used. Spring stays are made by placing two boards in an opening in the wall, placing a wedge between the two boards, nailing the ends of the boards

to the one-by-eight ledgers, and then driving the wedge tightly home toward the opening in the wall, thus locking the stay in place. When the scaffolding is between two buildings, it may be braced against the adjoining building. For the first story of a building, the scaffold may be stayed by sloping braces nailed to stakes driven into the ground. The putlog itself is sometimes used as a stay by driving a wooden wedge on top of the putlog into its hole in the wall and fastening the wedge in place with nails. In this case, the putlog should be nailed to the pole.

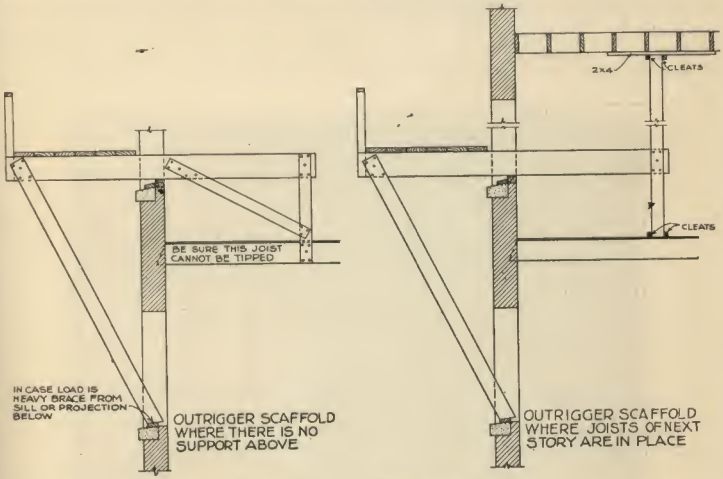


FIG. 40.—Outrigger scaffolds.

42. *Splicing.*—When the wall is higher than the length of the pole, two poles may be spliced together by nailing cleats as wide as the pole and about 3 ft. long, to opposite faces of the poles. Diagonal braces should be nailed across the outside of the poles.

43. Care must be taken to nail everything firmly, as the life of the worker depends upon the scaffold standing up under its heavy load of men, brick, mortar, and equipment. Never nail anything temporarily—it may be forgotten.

44. The scaffold planks should not be allowed to remain upon the scaffold after the working level above them is in use,

as falling mortar will splash on the wall when it hits the planks.

45. *Outriggers.*—An "outrigger" is a steel or a wooden beam projecting from a building to support or suspend a scaffold. In buildings where the floor is of wood, the outrigger beam may rest upon the ledge and be held by a length of board fastened to the joists. In steel construction a steel I beam is used for an outrigger. It is fastened to the steel frame work of the building by steel rods bent in the shape of a U, threaded on both ends and tightened around the outrigger and the beam through a flat strap of steel or wood. Scaffold planks are sometimes placed upon the outrigger and the work carried up by means of trestles placed upon the planks. (Fig. 40)

FIG. 41.—Outrigger scaffold in use.

46. *Suspended Scaffold.*—The suspended scaffold is popular in large jobs upon buildings of steel or reinforced concrete frame construction where the framework for several stories is erected ahead of the brickwork, thus furnishing a support for suspending the scaffold. The scaffold is suspended by cables attached to outriggers with winding drums upon the scaffold platforms. As the brickwork rises, the ends of the cables may be attached to outriggers at higher levels without disturbing the bricklayers. This form of scaffold is most suitable for inclosing during cold weather.

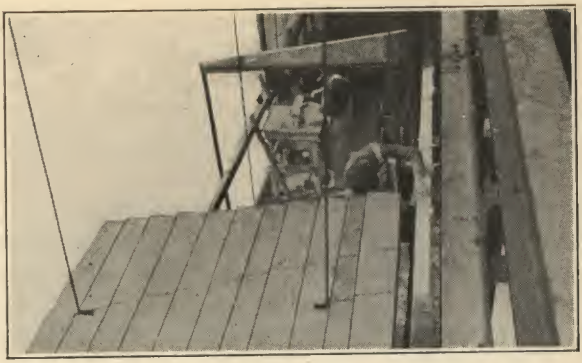


FIG. 42.—Method of enclosing suspended scaffold for winter construction.

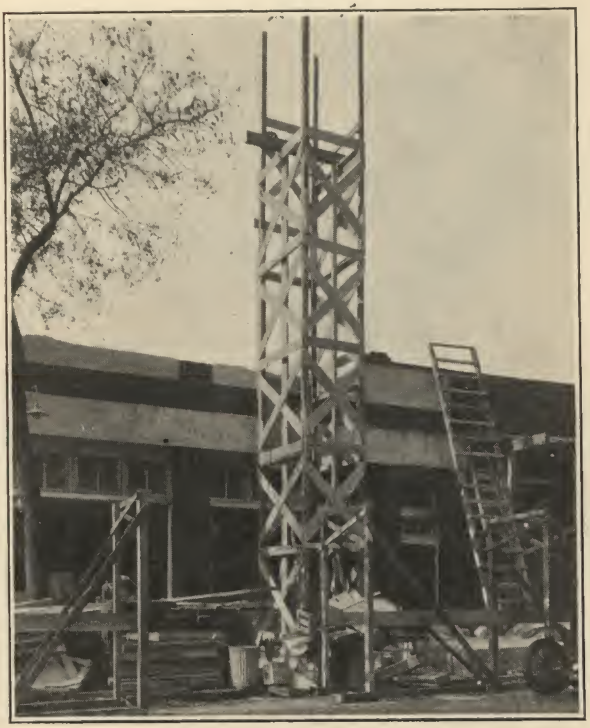


FIG. 43.—Material hoist.

47. Derrick.—A derrick is sometimes used for hoisting bricks, mortar, and other materials. Power is supplied by an electric or gasoline motor, by a steam engine, or by hand. It consists of an upright mast and a boom pivoted at the bottom of the mast. The whole may turn in any direction and the boom may be raised and lowered.

48. Material Hoists.—Material hoists operated by horse, steam, gasoline, or electric power are used upon medium and large construction jobs. They reduce the necessary number of runways and ladders, as materials may be carried directly to the level on which the men are working. Where suspended

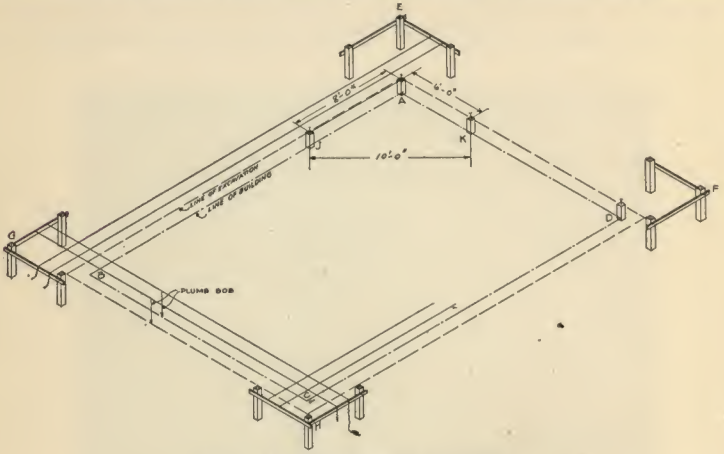


FIG. 44.—Laying out a building.

scaffolds are used, the hoist is frequently erected in such a manner that the wheelbarrows may be run directly on the scaffold from the hoist at any height (Fig. 43).

49. Batter Boards.—In laying out a building three stakes are often driven in the ground about 3 ft. away from the line of the wall at each corner of the building. Batter boards (1 by 4 or 6 in.) are nailed to the stakes forming a right angle parallel with the walls. Saw cuts are made in the board for holding the lines in the correct position. The batter boards may be squared by laying out a triangle on the ground with length of sides in the proportion of 6, 8, and 10, forming a triangle, the 6 and 8 sides paralleling the walls (Fig. 44).

UNIT V–A

BONDS

1. Definition.—Bond is an arrangement of built up brick or other units laid so that their overlapping thoroughly ties the units together, enabling the whole to act as a unit in resisting stresses.

2. Elasticity of Brick Walls.—As a brick wall has tremendous bearing capacity, it is seldom called upon to support more than a small fraction of the load that it will easily carry. Occasionally, a foundation settles unevenly, and in such cases the superimposed wall is subjected to lengthwise stresses. Because of its many small units, a brick wall will accommodate itself to a certain degree of uneven settlement without developing serious cracks.

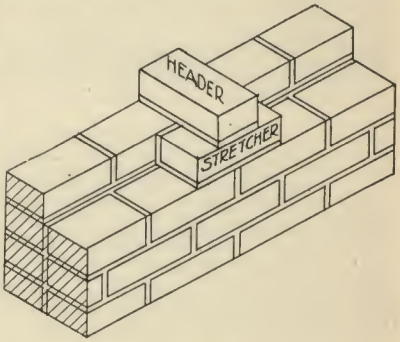


FIG. 45.

3. Selection of Bonds.—In selecting the bond, due consideration must be given to appearance and cost. Brickwork has such great strength that only occasionally will this be a factor in the selection of the bond. One must consider the bond in relation to the type of brick to be used, the joint to be selected, and the color of the mortar. A great variety of pleasing geometrical patterns may be secured by skillful design.

4. Stretchers.—Brick laid lengthwise of the wall with their longest edges parallel to the face of the wall are called stretchers.

5. Headers.—Brick laid at right angles to the stretchers or across the wall with their ends parallel to the face of the wall are called headers. Header courses cost more to lay than

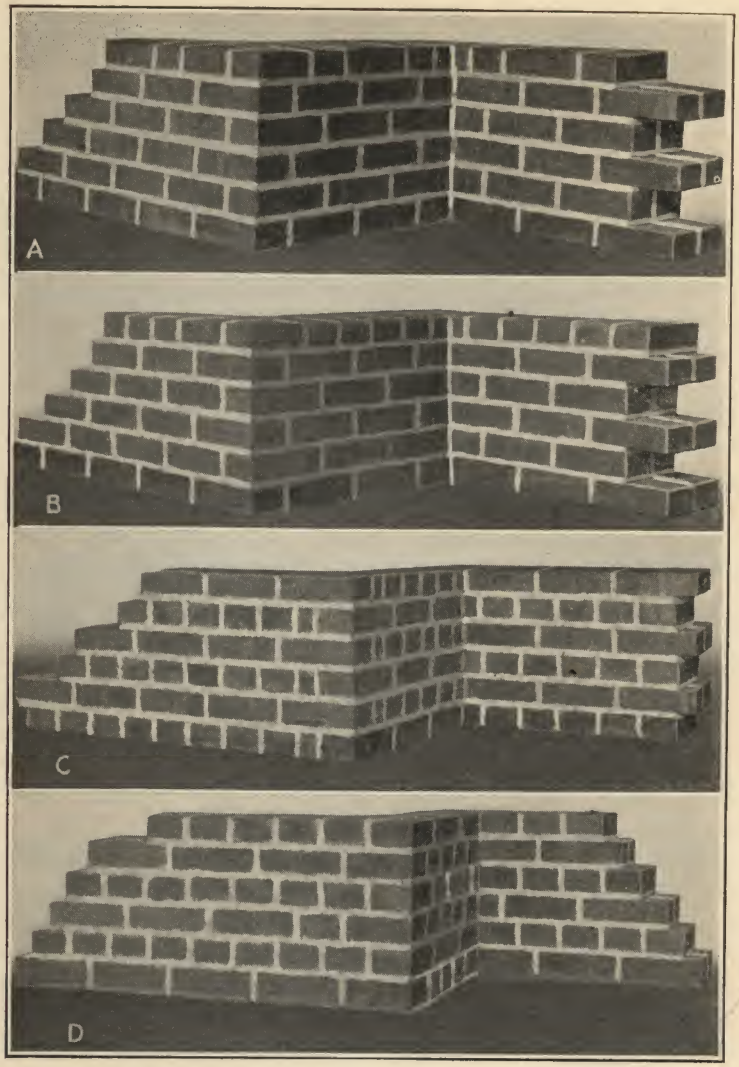


PLATE I.—Various types of bond. *A*. Common bond, Flemish header course. *B*. Common bond, full header course. *C*. English bond, closers at corners. *D*. Dutch bond.

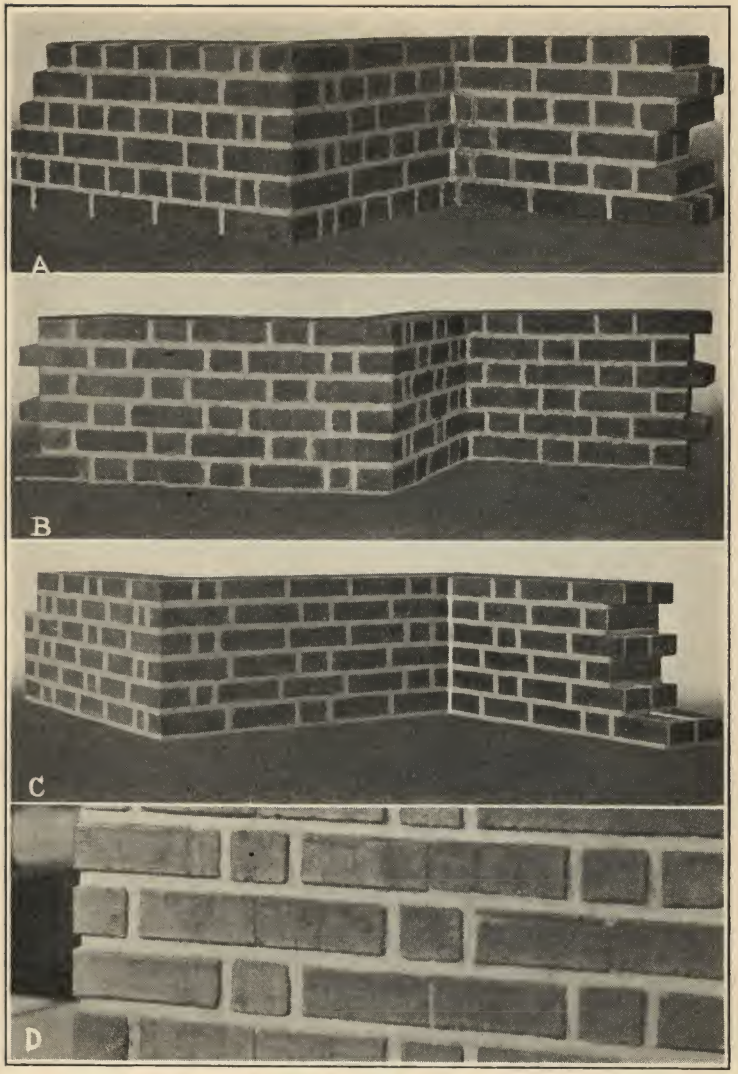


PLATE II.—Various types of bond. *A*. English cross bond, closers at corner. *B*. Flemish bond, closers at corners. *C*. Garden wall bond. *D*. Double stretcher Flemish bond.

stretcher courses and should be used only in sufficient quantities properly to tie the wall together in walls constructed for strictly utilitarian purposes and for backing up (see Fig. 45).

6. The Use of Headers.—In a wall constructed of common brick, all of the headers showing upon the face of the wall are

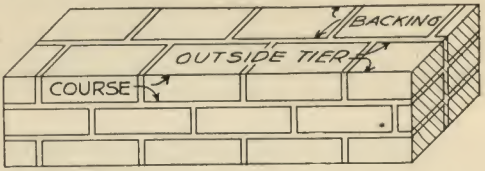


FIG. 46.—Illustrating the use of various terms.

through headers. As face brick is more expensive than common brick, wherever through headers are not necessary, it is sometimes customary to use "bats" (half brick) where headers are to appear upon the face of the wall. Where bats are used, be careful to cut the brick so both halves can be utilized and so avoid waste. The minimum spacing of header

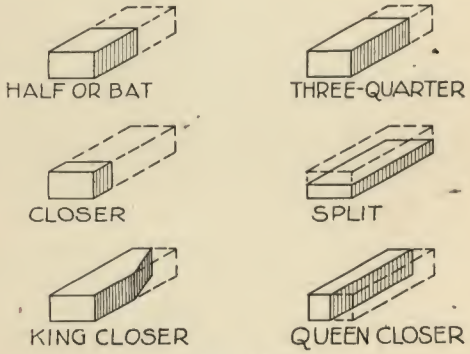


FIG. 47.

courses is generally defined by local building ordinances and varies from every fifth to every seventh course.

7. Vertical Joints.—Vertical joints in courses of the same construction should be perpendicularly over each other; otherwise the neat appearance of the wall will be spoiled and the brickwork will look slovenly. Keeping vertical joints in

line is called "keeping the perpends" or "keeping the end joints plumb."

8. Bats and Closers.—It is frequently necessary to clip some of the brick to varying lengths in order to fill spaces and carry

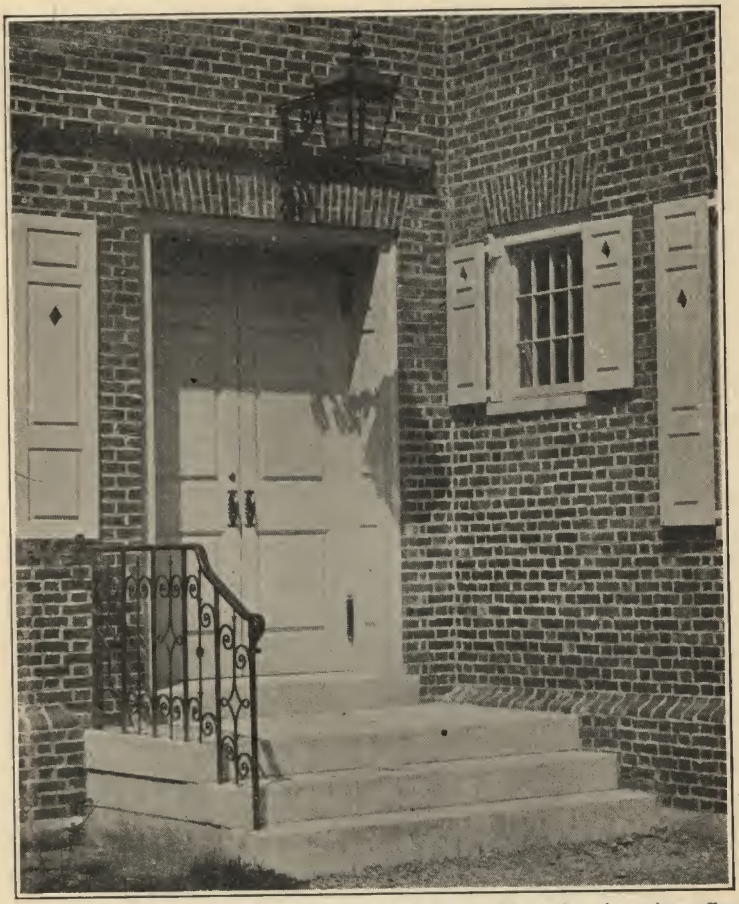


FIG. 48.—Flemish bond with concave joints. Note the charming effect of the contrast between light mortar and darker brick. Note also special plinth blocks and gauged "Jack" arches.

the wall to the corner. A half brick is commonly referred to as a bat; three-fourths of a brick is referred to as a "three-quarter;" a quarter of a brick is commonly called a "closer,"

sometimes spelled "closure." A "queen closer" is a brick clipped diagonally across the end, leaving only one-half of the end face; a "split" is a brick split in two with the break parallel to the bed of the brick. A "king closer" is a brick cut so that it tapers from a width of 2 in. at one end to a width of 4 in. at the other. (Fig. 47)

9. Fundamental Bonds.—Fundamentally, there are only three types of bond in good brickwork, running bond, English bond, and Flemish bond; the multitude of diagonal pattern bonds are simply variations of the two latter types. English bond consists of alternating courses of headers and stretchers. Flemish bond consists of alternating headers and stretchers in each course.

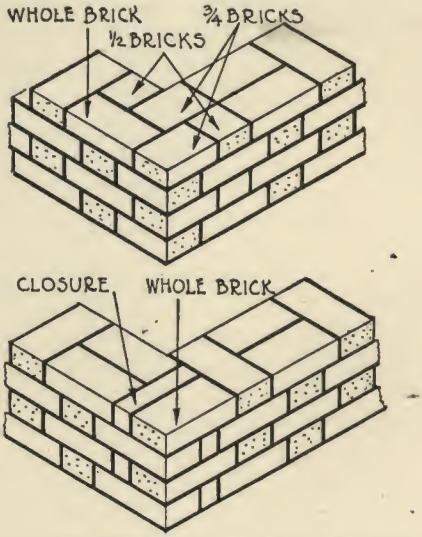


FIG. 49.—(Upper) Dutch corner. (Lower) English corner.

10. Dutch and English Corners.—Before describing the bonds, attention is called to two distinct methods of starting corners in English and in Flemish bond. To locate correctly the vertical joints, it is necessary to introduce at the corner a unit half a header in width. In English brickwork a header split in half, or closer, is used, but in Dutch brickwork the

closer is eliminated and the same effect obtained by using a three-quarter brick in the stretcher courses. If a closer is used, never place it directly at the corner. Start with a full header, followed by the closer.

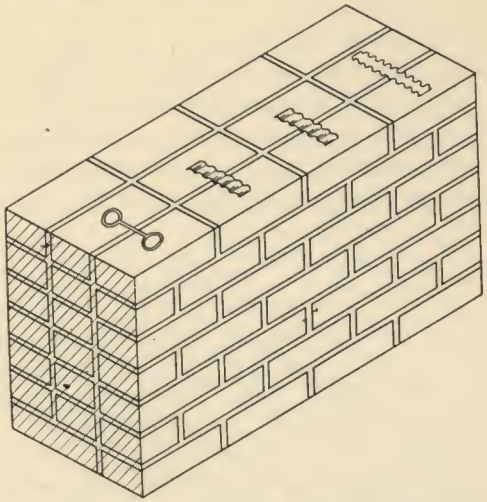


FIG. 50.—Running bond with various types of metal ties.

11. Running Bond, or Stretcher Bond.—Running bond does not, strictly speaking, comply with the definition of "bond" given in paragraph 1 of this chapter, and cannot, therefore, be called a real bond, inasmuch as it is apparent that

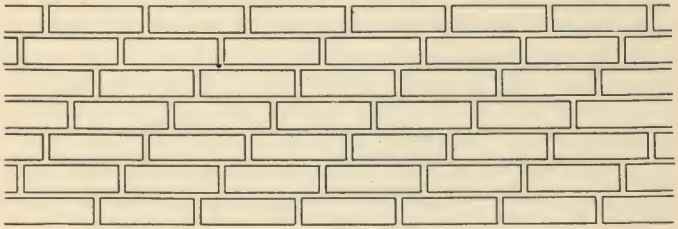


FIG. 51.—Variation of stretcher bond.

being composed entirely of stretchers it provides for longitudinal strength only. In its most usual form running bond consists of stretchers laid so that the end of each stretcher breaks joint at the center of the stretchers in the courses above and

below. In a variation of this bond the stretchers may overlap for a distance of only a quarter of a brick, as illustrated in Fig. 51. It is obvious that some means must be employed to tie the outside tier of a wall of this type to the backing. This is accomplished by

a. The questionable use of metal wall ties as shown. It is obvious that such wall ties cannot transmit any considerable portion of the load to the outside tier of the wall. The backing, therefore, must be relied upon entirely to carry the load and resist any other stresses. Such anchors are also likely to rust; although if they are entirely covered with mortar and

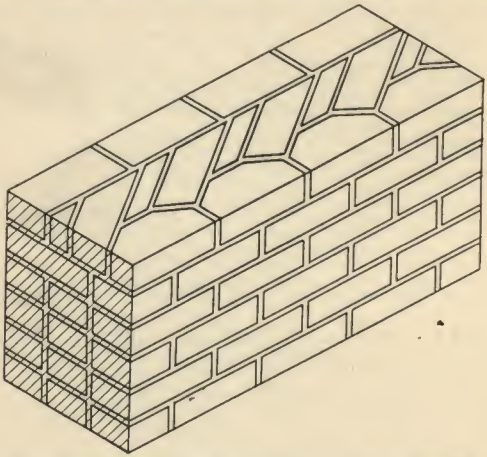


FIG. 52.—Stretcher bond tied to backing with clipped bond.

have been galvanized after being cut, they are less likely to do so. Some careless bricklayers push the metal ties into the soft mortar after the brick are laid. This should never be done, as the mortar will not then completely cover and bind the tie in place, and if pushed in too far, the tie will not lap the required distance over the brick in the adjoining tier. *b.* At every few courses, brick in the backing are laid diagonally, the triangular portion of the brick projecting beyond the backing, forming a tie sufficient only to attach the outside tier to the backing. This is called clipped bond, and while it forms a better tie between backing and outside tier than

when metal wall ties are used, this bond cannot be relied upon to transmit load from the backing to the outside tier. Considerable time is required for the clipping of the brick. Clipped bond has the disadvantage of being concealed and

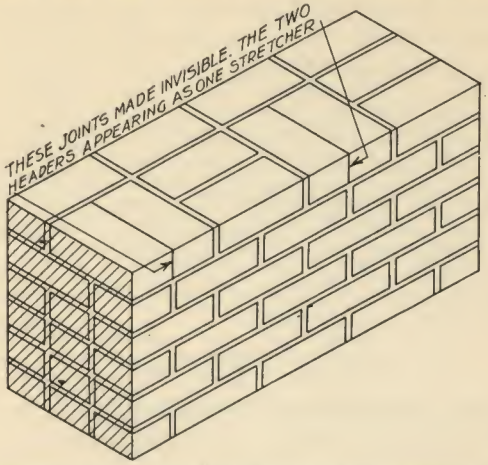


FIG. 53.—Stretcher bond tied to backing with pairs of headers. Blind joints between.

offers an opportunity for careless workmanship. *c.* The most satisfactory method of bonding the outside tier in running bond is to place a row of headers at every fifth, sixth, or seventh course with a blind vertical joint between each pair so that

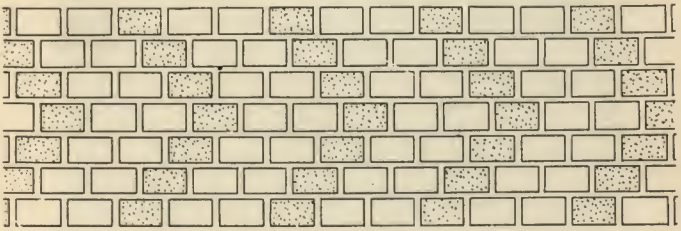


FIG. 54.—Running header bond.

the two headers together will appear as a stretcher. While this is good practice and gives a good strong wall by this method, the bond really becomes common bond. The vertical joint between each pair of headers may be concealed

either by having a very thin mortar joint between them or by coloring the mortar to imitate exactly the color of the brick.

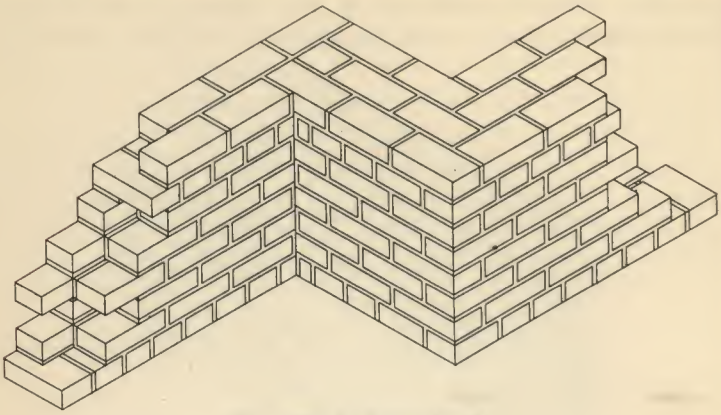


FIG. 55.—Common bond.

12. Running Header Bond.—Another type of running bond is the running header bond. If desired, variegated brick may be used to provide either straight diagonal lines or a zigzag, as shown in Fig. 54.

FIG. 56.—Laying 12 in. common bond wall. Note overlapping of header courses.

13. Common Bond.—Common bond is really a type of running bond. For unexposed work and exposed work where cost is the main item, common bond may be laid more quickly

and is as strong if not stronger than other bonds. Common bond, or American bond, as it is sometimes called, if carefully laid, produces a pleasing and artistic effect and has been used to good advantage on many important buildings. Common bond is laid in the same way as running bond, but with a course of headers every fifth, sixth, or seventh course. The

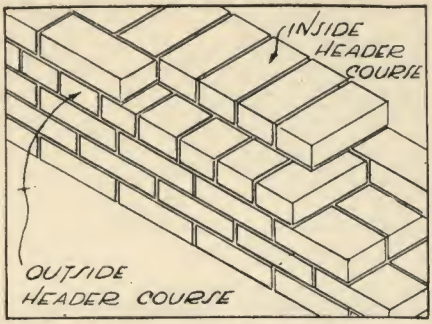


FIG. 57.—Header courses in 12 in. wall, common bond.

header course is laid either entirely of headers or of alternate headers and stretchers, the latter being called a Flemish header course. It is the most commonly used of all bonds because it is the lowest in cost. At the corner of the wall in each header course, it is necessary to lay a three-quarter brick. In a 12-in. wall, it is necessary to use two header courses

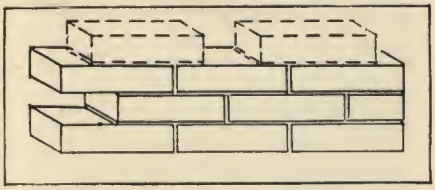


FIG. 58.—Greatest permissible shifting of stretchers to assume good bond in unexposed work.

overlapping in the center and extending to the opposite sides of the wall. For appearance, vertical joints should be kept perpendicular over each other. Under no conditions should the end of a stretcher be less than 2 in. from the end of the stretcher below it in unexposed work where appearance is not a factor. (See Fig. 58.)

14. English Bond.—English bond consists of alternating courses of headers and stretchers, the headers being centered on the stretchers, the ends of the stretchers all being in vertical

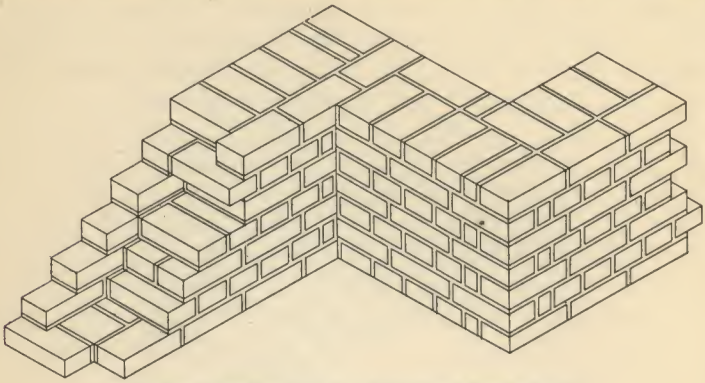


FIG. 59.—English bond. Common bond backing.

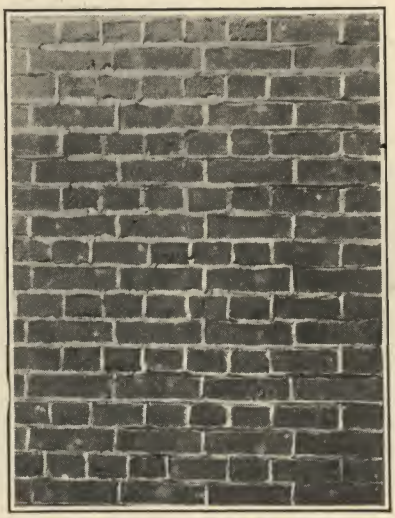


FIG. 60.—English bond with Dutch corner.

lines in every course that contains them. At the corners a closer must be placed in each header course next to the corner brick or a three-quarter brick used in the stretcher course to

take the place of the closer in the stretcher course. Interesting patterns may be formed on the face of the wall when using English bond as here illustrated (see Fig. 61).

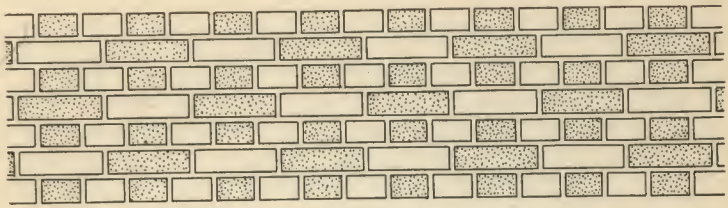


FIG. 61.—One of many methods of emphasizing patterns in English bond.

15. English and Dutch Cross Bond.—English cross bond, also called Dutch cross bond or Dutch bond is a variation of English bond. Instead of the ends of all of the stretchers aligning with the stretchers in courses above and below, they are made to break joint by inserting a header next to the

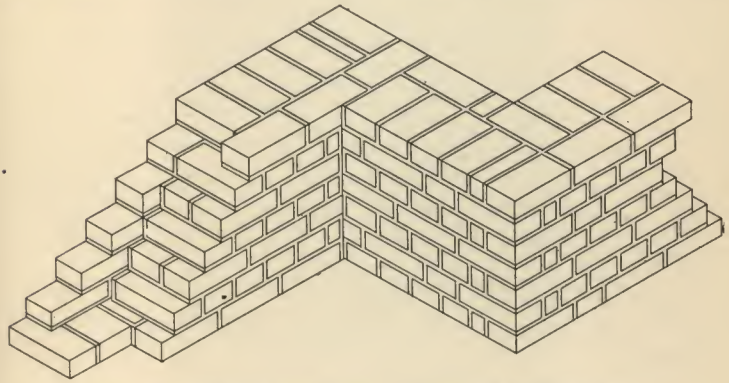


FIG. 62.—English cross bond. Common bond backing.

corner brick in every other stretcher course. The only difference between English and Dutch cross bonds is in the method of starting the corner. The English cross bond is started with an English corner, that is, a closer next to the corner header in every header course. With the Dutch corner, the stretchers are laid continuously from the corner without

closers but a three-quarter brick is laid at the corner to start each stretcher course. The face of the wall is identical in both English and Dutch cross bonds.

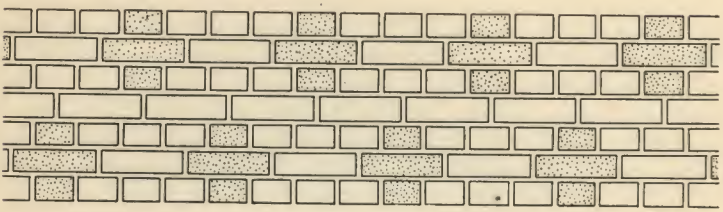


FIG. 63.—One of many methods of emphasizing patterns in English cross bond.

16. Flemish Bond.—Flemish bond is the third of the three fundamental bonds and consists of alternate headers and stretchers in every course, each header centering on the stretchers in the courses above and below. At the corners closers, or three-quarter brick, are necessary.

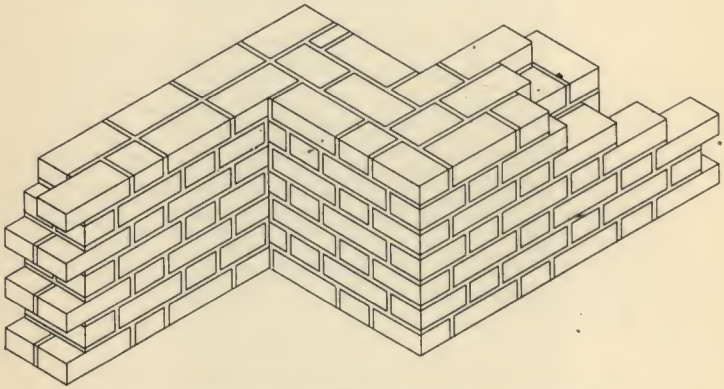


FIG. 64.—Single Flemish bond; Dutch corner.

17. Single and Double Flemish Bond.—Single Flemish bond consists in obtaining the Flemish bond effect on the outside of the wall only, the backing being common bond and the majority of the exposed headers being bats. This is the most usual type of Flemish bond wall. Where both the

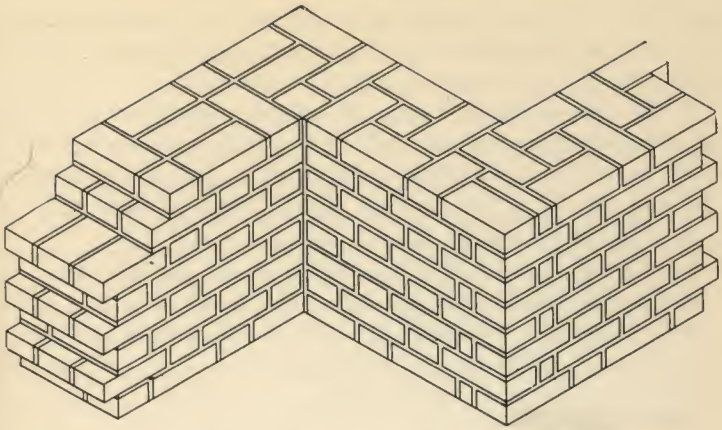


FIG. 65.—Double Flemish bond. English corner.

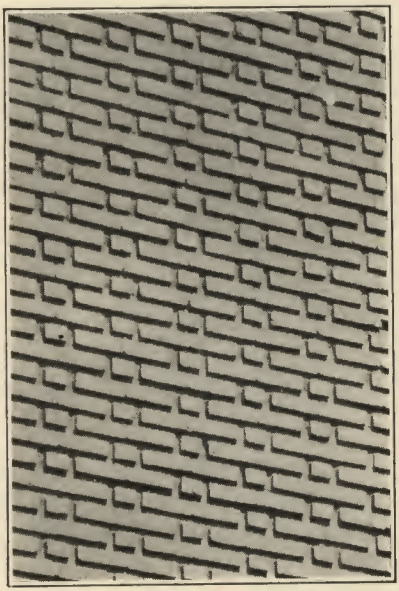


FIG. 66.—Double stretcher Flemish bond, stripped joints.

inner and the outer surfaces of the wall are exposed, both being laid in Flemish bond—all headers true headers and not bats—the bond is termed double Flemish bond.

18. Double-stretcher Flemish Bond.—Another type of Flemish bond is obtained by constructing each course with two stretchers followed by a header and centering the headers over the stretcher joints, the joints between each pair of

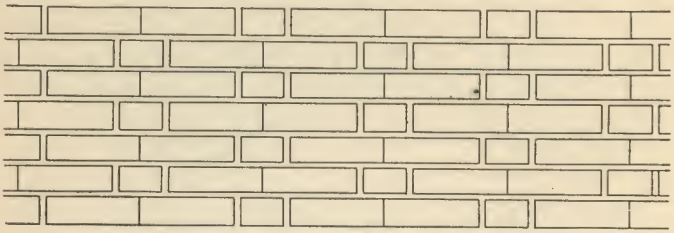


FIG. 67.—Double-stretcher Flemish bond.

stretchers being concealed, or blind, joints. The concealing of these joints constitutes the sole difference between double-stretcher Flemish bond and double-stretcher garden wall bond, in which latter the joint has the usual appearance. This bond is also sometimes incorrectly termed "double Flemish bond."

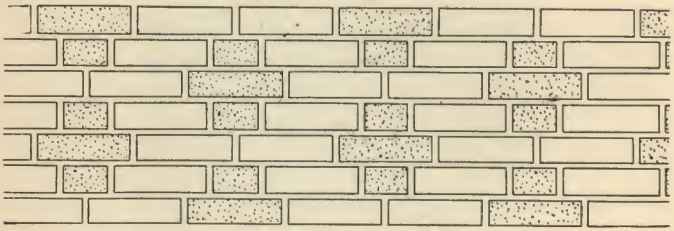


FIG. 68.—Flemish cross bond.

19. Flemish Cross Bond.—Flemish cross bond consists of alternate stretcher courses and Flemish header courses in which the headers are all in vertical lines while the stretchers in each course break joint.

20. Flemish Spiral Bond.—This is another variation of Flemish bond in which each course is laid with alternate headers

and stretchers with the headers breaking joint over each other. By the use of darker brick for the headers diagonal lines are formed on the surface. This bond may be used for circular work, and sometimes for chimneys.

21. Garden Wall Bond.—This wall, as illustrated, was commonly used for 8-in. garden walls and consists of three

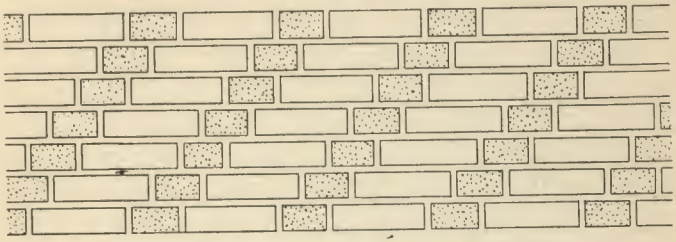


FIG. 69.—Flemish spiral bond.

stretchers in each course followed by a header, the headers in each course centering between the headers in the courses above and below. Where the wall is built with two stretchers followed by a header, it is called double-stretcher garden wall bond. Garden wall bonds may have from two to five stretchers between headers.

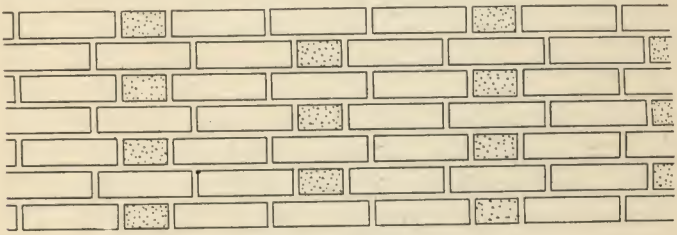


FIG. 70.—Garden wall bond.

22. Bond Pattern Units.—We here illustrate the system representing various units upon which all diagonal pattern bonds are based. These are constructed by varying the bond, and shifting the relation of the headers and stretchers in various ways. An example showing one practical application is shown in fig. 71. As will be seen, the variations which may be worked out are almost endless.

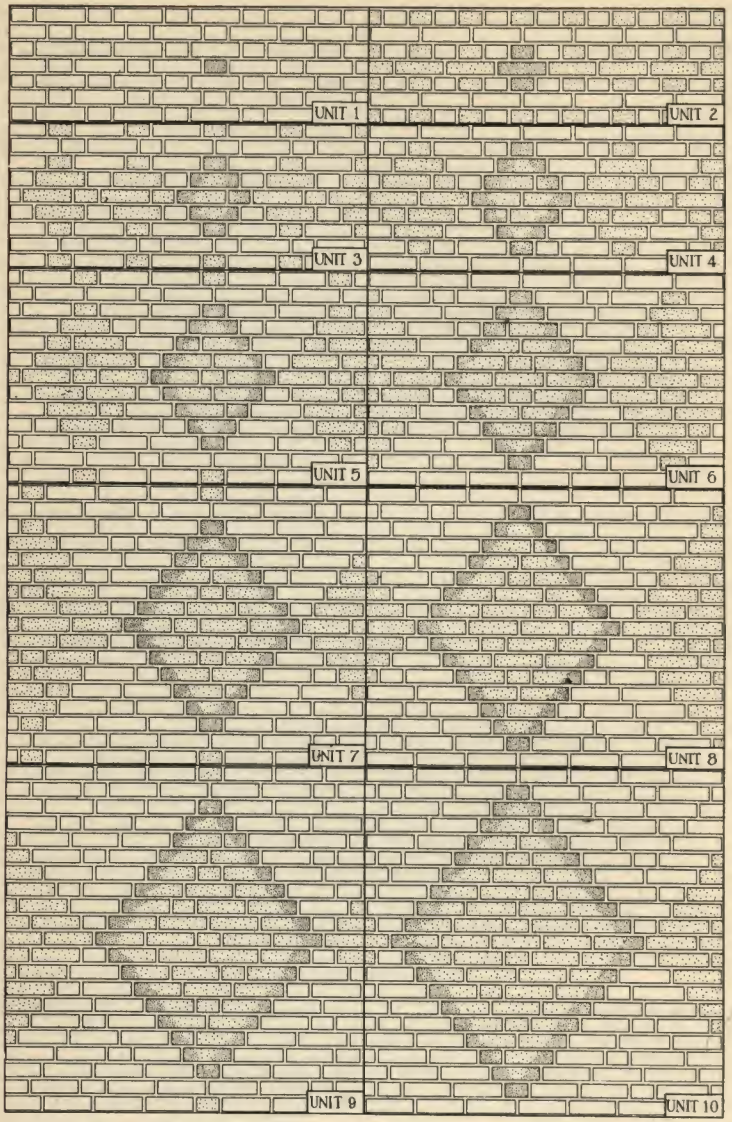


PLATE III.—Units upon which pattern bonds are based.

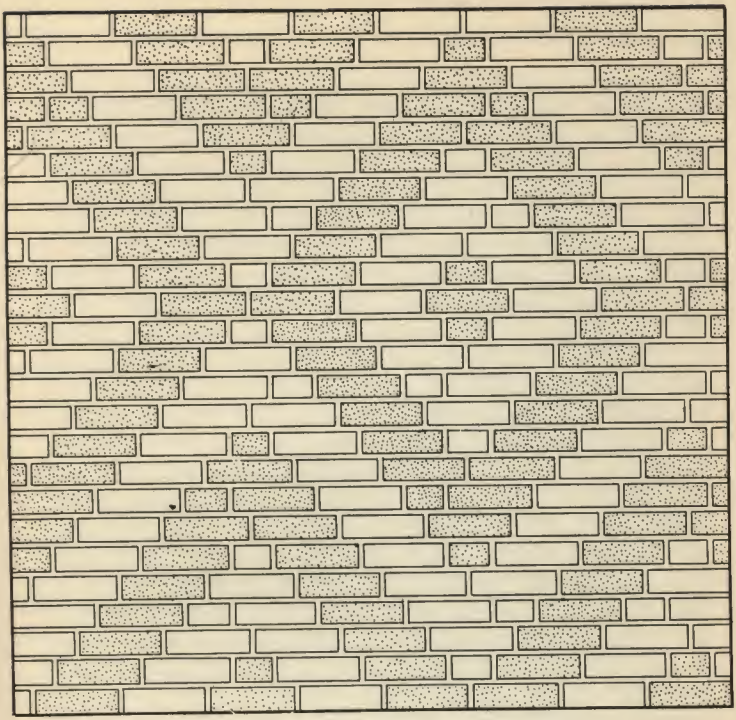


FIG. 71.—An example of pattern bonding.

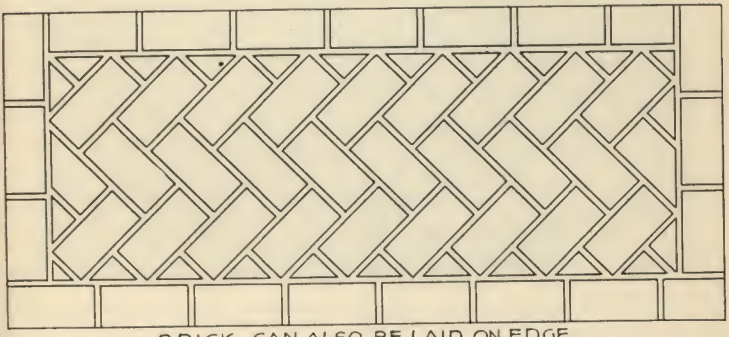


FIG. 72.—Herring-bone pattern.

23. Herringbone Pattern.—For panels in walls, for brick nogging with half timber, etc., and for walks, a herringbone

FIG. 73.—Illustrating use of herringbone pattern in upper part of porch

pattern is frequently used. It is also used for cores of arches. It consists of a zigzag course of brick, either laid flat or on

edge, the end of one brick being laid at right angles against the side of a second brick. In paving, the brick may either be laid flat or on edge. (Fig. 72)

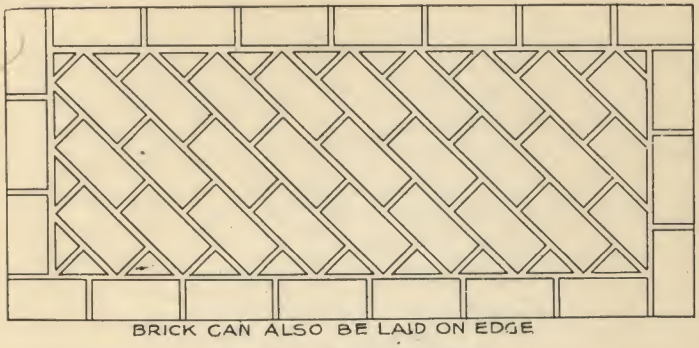


FIG. 74.—Diagonal pattern.

24. Diagonal Pattern.—A diagonal pattern may be used for the same purposes as the herringbone pattern, the brick being laid end to end at an angle. This is sometimes used as a bond when backing up heavy piers or walls, alternate courses being laid at right angles to each other.

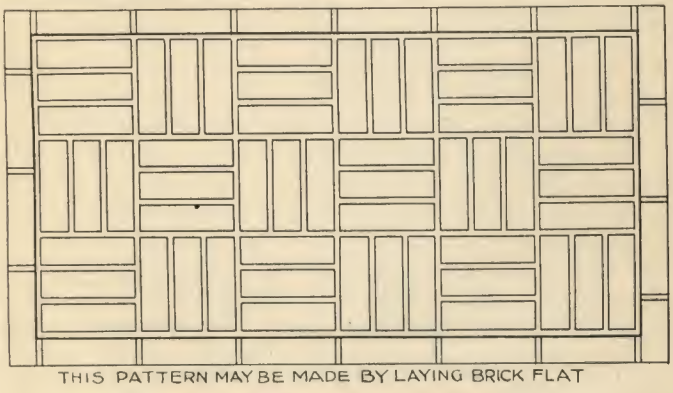
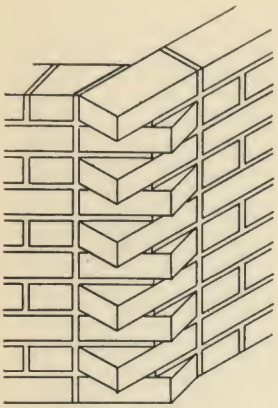


FIG. 75.—Basket weave pattern.

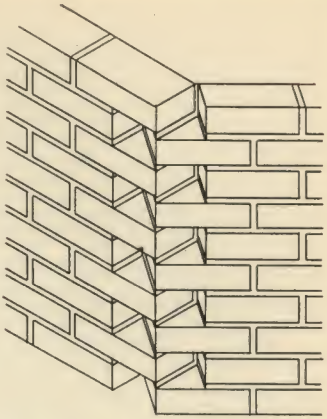
25. Basket, Block, or Diaper Pattern.—Basket, block, or diaper pattern is laid in square blocks of parallel brick, each block laid at right angles to the block adjoining, as illustrated.

26. Squint Quoins.—External angles other than right angles are called "squint quoins." These require some care in laying



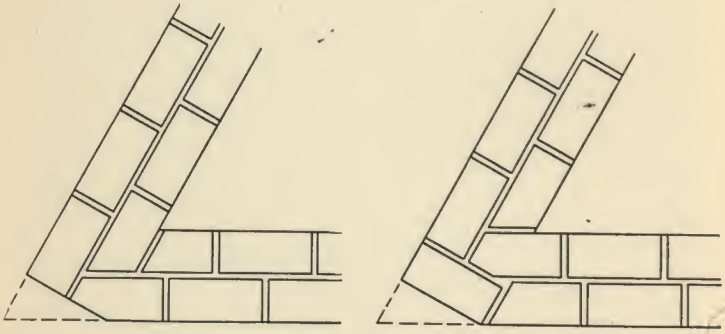
OBTUSE SQUINT QUOIN WITH UNCUT BRICK. THE PROJECTING BRICK ENDS MAY BE CUT OR RUBBED FLUSH WITH WALL SURFACES

FIG. 76.—Obtuse squint, projecting brick.



OBTUSE SQUINT QUOIN WITH UNCUT BRICK LAID TO FORM PIGEONHOLES WHICH REDUCE EFFECTIVE WALL THICKNESS, TEND TO CONDUCT WATER TO INTERIOR OF WALL AND GATHER DIRT

FIG. 77.—Obtuse squint with pigeonholes.



ACUTE SQUINT QUOINS SHOWING ALTERNATE COURSES

FIG. 78.—Acute squint.

out, to preserve the bond and secure a good appearance. Obtuse angle squints are sometimes left with a series of pigeon

holes as shown. This is not good practice, as the holes may conduct water to the inside of the wall. A better method is to allow the uncut corners to project, as shown. Sometimes it is

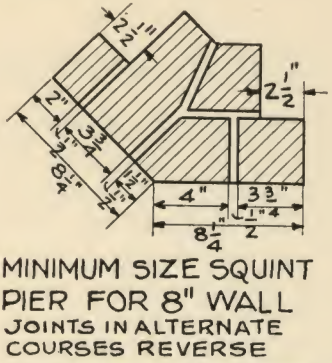


FIG. 79.—Smallest pier for bay window corner.

preferable to cut the corners so that the corners of the bricks will not project beyond the normal plane of the brickwork. A layout for a minimum size squint pier recessed for a double-hung window frame in an 8-in. wall is also shown.

UNIT V–B

SKINTLED BRICKWORK

1. Skintled Brickwork May Not Be Recent.—Even with such an ancient material as brick, universally employed in building construction from the days of the earliest civilization, new developments are still possible in the methods of its use. It would be rash to say too positively, however, that these developments have never been used before, when one considers that skilled craftsmen of every race which has had a place in history have been experts in the use of this material, and must have developed what were then new ways of using it that may have waxed popular and then given way to other styles of workmanship while the world was still young.

2. An instance of this kind occurred when the Ideal wall was brought to the attention of the building public a few years ago. At that time it was thought to be new, but examples of its use were found in many countries of Europe, and from China came a report that the Ideal wall had been used there for many hundreds of years. In the same way, skintled brickwork, here described as new, may have been perfectly familiar to craftsmen of some bygone day, although no examples are known to exist nor are these methods described in any literature coming to our attention before the publication of this book.

3. The credit for this development belongs to prominent architects of Chicago who saw new opportunities for artistic effects with common brick. They have created a new style in bricklaying which has been followed in several hundred pretentious residences in the northern suburbs of that city along the shores of Lake Michigan, and is already being copied in other cities.

4. Definition.—Skintled brickwork is an arrangement of exposed brickwork in which the bricks in the outside tier

are laid irregularly with respect to the normal plane of the face of the wall, being set in and out at random or in various combinations to produce an uneven effect.

5. The name applies also to walls in which a rough effect is produced by the mortar squeezed out of the joints being allowed to project irregularly beyond the face of the wall; in which case the bricks may be laid parallel with the line as with ordinary brickwork, or laid in and out as before described.

6. A few of these effects are illustrated here, the larger photographs showing the general effects obtained, the smaller pictures showing exactly how the brick are laid.

Clark & Walcott, Architects

FIG. 80.—Skintled brickwork; C. B. M. A. effect number one.

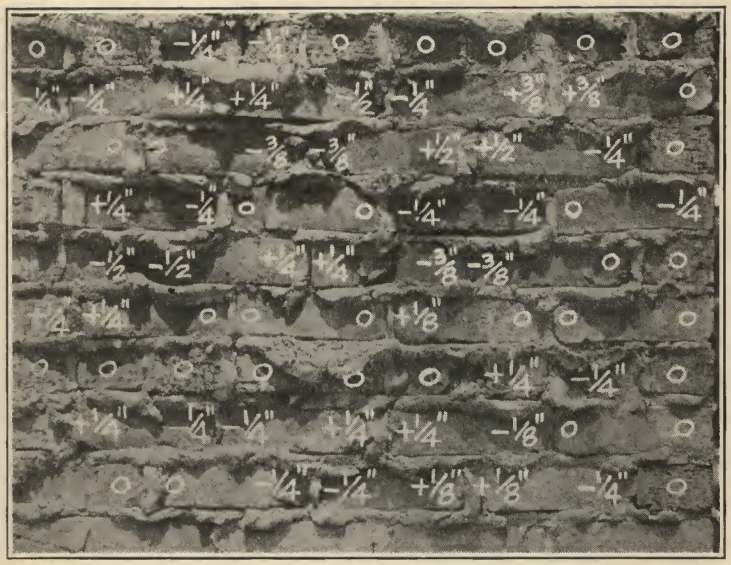


FIG. 81.—Detail of skintled brickwork; C. B. M. A. effect number one. Plus dimensions indicate projection beyond wall line. Minus dimensions indicate set-back from wall line.

S. S. Beman, Architect

FIG. 82.—Skintled brickwork; C. B. M. A. effect number three.

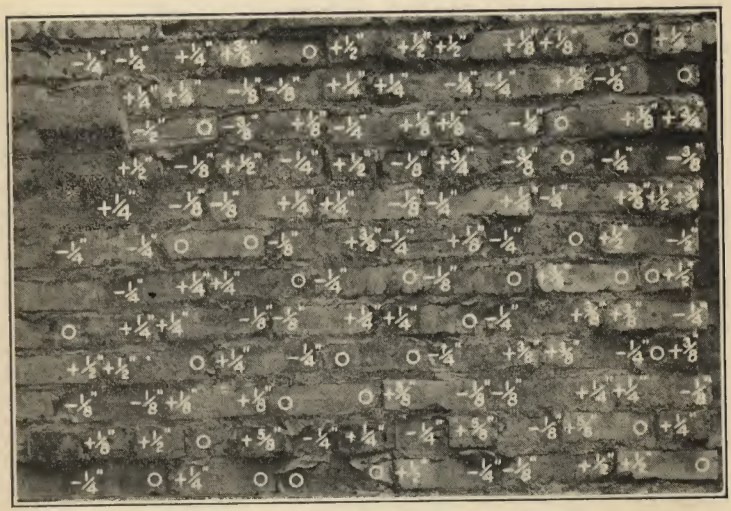


FIG. 83.—Detail of skintled brickwork; C. B. M. A. effect number three. Plus dimensions indicate projection beyond the wall line. Minus dimensions indicate set-back from wall line.

James Roy Allen, Architect

FIG. 84.—Skintled brickwork; C. B. M. A. effect number five.

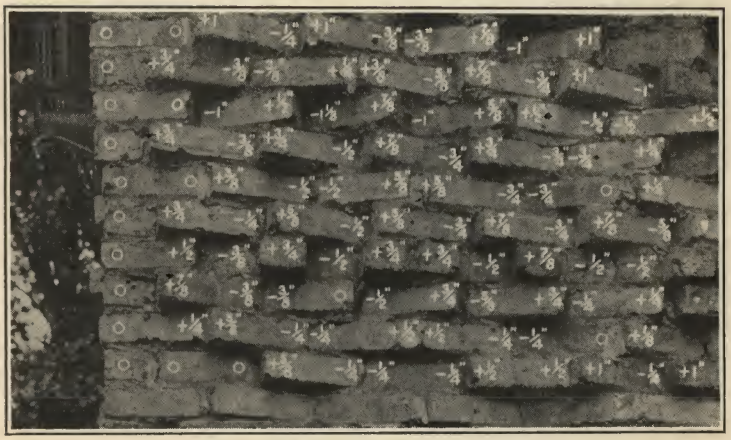


FIG. 85.—Detail of skintled brickwork; C. B. M. A. effect number five. Plus dimensions indicate projection beyond wall line; minus dimensions indicate set-back from wall line.

James Roy Allen, Architect

FIG. 86.—Skintled brickwork; C. B. M. A. effect number six.

FIG. 87.—Detail of skintled brickwork; C. B. M. A. effect number six. Built of brick over fired to point of incipient fusion, with consequent warping and swelling.

Russel Walcott, Architect

FIG. 88.—Skintled brickwork; C. B. M. A. effect number seven.

FIG. 89.—Detail of skintled brickwork; C. B. M. A. effect number seven. Plus dimensions indicate projection beyond wall line.

UNIT VI

ROWLOCK COURSES, SOLDIER COURSES, AND PANELS

1. Rowlock.—A course of brick laid on edge is known as a rowlock course.

2. Rowlock Header.—When the brick are laid on edge so that only the ends show on the face of the wall, a rowlock header course results.

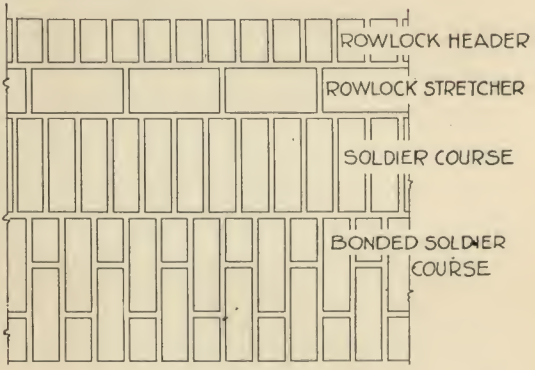


FIG. 90.

3. Rowlock Stretcher.—When the brick are laid on edge so that only their broad sides show on the face of the wall, the method is known as a rowlock stretcher course.

4. Soldier Course.—Brick laid on end with the side or face of the brick on the face of the wall is known as a soldier course.

5. Bonded Soldier Course.—Decorative courses are frequently carried across the wall in various bonds and are known as bonded courses.

6. Panel.—A brick panel is a section of brickwork marked off in one of various ways and contained within a border, and forming a feature of the brickwork. The range of effects which

may be obtained in this manner is very wide. A panel may be a portion of the brickwork sunk or raised beyond the normal face of the work; or in other cases various colored brick,

FIG. 91.—Wall built entirely of rowlock stretchers.

mortar, tile, stucco, wood, and various patterns in laying the brick may be used.

FIG. 92.—Tapping a brick in soldier course into place.

FIG. 93.—Plumbing a brick in soldier course. Note stripped vertical joint.

7. Inserts.—Inserts of tile, stone, terra cotta, selected brick, etc. are frequently built into a wall for decorative effect.

UNIT VII

JOINTING

1. Definition.—Jointing is the operation of finishing the exterior surface of the mortar joints.

2. Uses.—In selecting the joint to be used, it is necessary to consider the effect desired and the speed with which the jointing may be done. Smoothing the surface of the mortar with a steel tool tends to make the mortar more compact and in some joints gives a slope that will shed water. Consideration should be given the fact that too deep a joint may form a

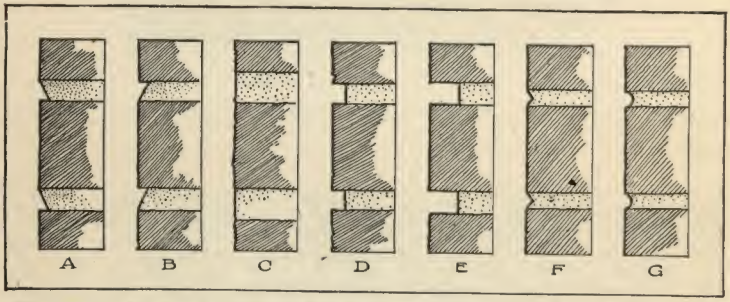


FIG. 94.—*A*. struck joint. *B*. weathered joint. *C*. flush or plain cut joint. *D*. raked joint. *E*. stripped joint. *F*. "V" joint. *G*. concave joint.

water pocket. Some joints tend to hide irregularities in the laying and in the shape of the brick. A joint should be considered as to its width, its cross-section, its color, and its texture.

3. Width of Joint.—With brick of standard size a joint of approximately ½ in. plus the width of two headers equals the length of a stretcher. By varying the width of the vertical joints, joints up to ¾ in. may be made. Wider joints than this are used, although joints ¾ in. and above require a coarser aggregate. Care must be taken to keep horizontal joints of

uniform thickness. Laying too heavy a joint at one end of the wall will soon make a variation of a course when a given height is reached.

FIG. 95.—Striking joints.

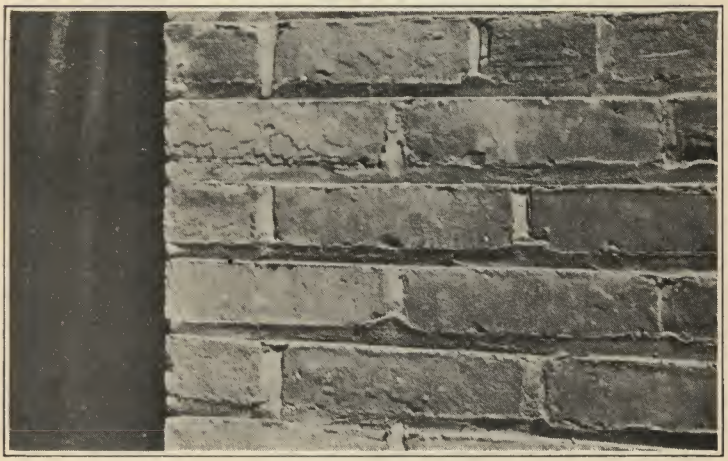


FIG. 96.—Struck joint.

4. Struck Joints.—For exposed brickwork, the struck joint is the fastest joint to make. It is more widely used than any other joint and is suitable for both outside and inside exposed

walls. It is first made as a "rough-cut" joint and is then struck upwards with the edge of the trowel well towards its point, the handle of the trowel coming above the joint. It is made after the mortar has stiffened a little. The angle of this joint is such that it leaves no shadow and brings into relief the top edges of the brick. As it is this edge that is laid "to the line," it makes a neat-looking job. The bricklayer will do a better job if he strikes his joints lightly, as a shallow joint helps to conceal irregularities. Only end joints

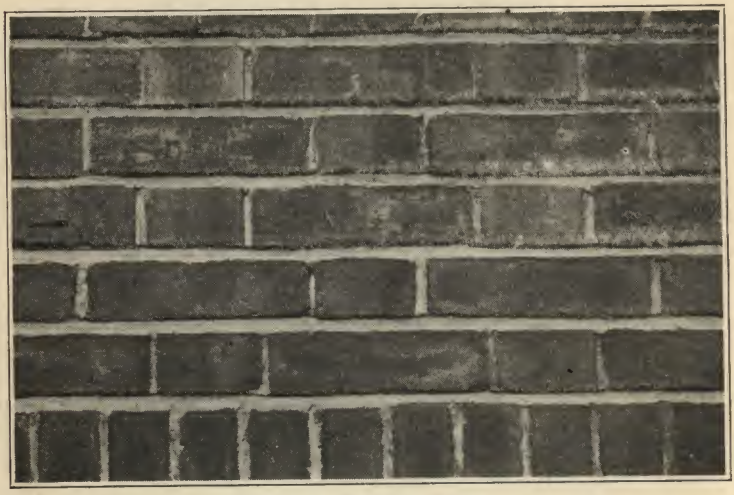


FIG. 97.—Weathered joint.

should be struck with the face of the trowel and then only when working from the inside of the wall; otherwise the back of the trowel should be used, as the face of the trowel, being covered with mortar, will smear the face of the wall. Unexposed wall surfaces which are to be waterproofed should have struck joints.

5. Weathered Joints.—The weathered joint is the reverse of a struck joint and is supposed to shed water better. It is more difficult to make and, therefore, is more costly. It is formed with the handle of the trowel lower than the joint, the joint being struck downward with the edge of the blade.

To keep a uniform slope on the face of the joint is difficult. The irregular surface thus formed, combined with the shadow of the brick above, shows up imperfections in the wall.

6. Plain- or Rough-cut Joints.—The plain-cut joint is a joint flush with the face of the wall, formed by cutting off the excess mortar with the edge of the trowel. It is a rough joint used for walls that are to be afterwards plastered or otherwise covered up.

7. Flush-cut Joints.—The flush-cut joint is similar to the rough-cut joint, but is formed more carefully. Very wide

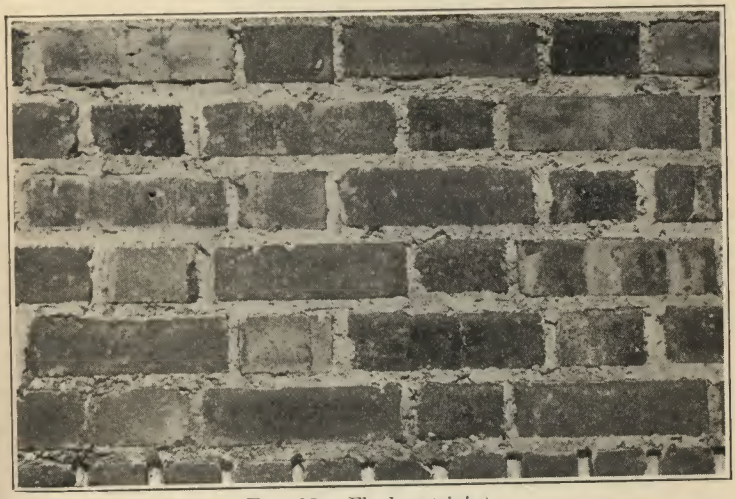


FIG. 98.—Flush cut joint.

flush-cut joints are commonly laid in mortar containing aggregate coarser than regular brick sand, to insure a stiffer mortar and to give a coarse texture. When brick of a coarse texture are used, care must be taken in trimming the mortar squeezed beyond the face of the wall, as it may get into the rough scoring of the brick and cannot be easily removed. The mortar should not be touched with the trowel after trimming, as it will have a tendency to draw the cement to the surface of the joint and spoil the rough effect. If the mortar in a rough wide joint begins to sag away from the brick, tap it carefully back into place with the rough end grain of a piece of wood.

8. Raked Joints.—The raked joint is first finished plain cut and is then raked out with a "jointer" to the desired depth.

FIG. 99.—Raking a joint.

FIG. 100.—Stripped joint.

When a rough finish is desired, a wooden stick is sometimes used for raking. Various special jointers are made for raking a rough joint to proper depth.

9. Stripped Joint.—In making a stripped joint, a strip of wood the thickness of the joint is laid at the front of the wall to the depth of the joint desired. The mortar is spread flush

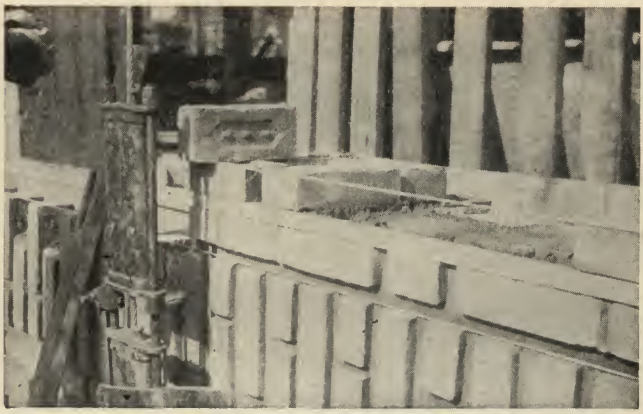


FIG. 101.—Forming stripped joint. Horizontal course in double-stretcher Flemish bond. Note "blind joint" between pairs of stretchers.

FIG. 102.—Forming concave joint.

with the top of the strip. The next course is then laid. After the mortar has set, the strips are removed. This type of joint costs a little more than a raked joint but makes a neater and cleaner job, as the joint is of even depth and thickness.

10. Miscellaneous Tooled Joints.—Joints of various sections are formed by first making a flush joint, afterwards running a jointing tool along the joint close to the top edge of the brick. For a beaded joint a straightedge may be used

FIG. 103.—Concave joint.

to guide the tool. Concave, convex, V and beaded joints are formed in this way. The vertical jointing should be done first. Under ordinary conditions it is best not to push the jointer deep enough into the mortar to show up the irregularities of the joints.

UNIT VIII

POINTING

1. Definition.—Filling exposed joints with mortar after the wall is laid is called pointing. Sometimes, in laying new walls, exterior joints are purposely left only partially filled and in very old walls the exposed mortar occasionally weathers away to some extent. Pointing is necessary in both of these cases.

2. Pointing Old Walls.—The surfaces to be pointed should be reasonably clean, the old mortar as rough as possible, and the wall well wetted down before pointing; followed by the immediate application of fresh mortar.

3. Tuck Pointing.—Tuck pointing is the process either of first filling the joints smooth with the face of the brick and then rubbing down the entire surface of the wall with a soft brick, so that brick and joints are the same color, or of coloring the entire wall with a compound of copperas and the pigment required. Lime putty is then pressed on to the joints in straight lines, and with a jointer working to a straightedge with a beveled edge the edges are trimmed with a tool called a Frenchman, which usually consists of a table knife with the end of the blade turned up at right angles. The edge of the knife cuts the putty and the turned up end cuts off the superfluous material, leaving a white joint $\frac{1}{4}$ in. wide and $1\frac{1}{6}$ in. thick on the face of the work. A half tuck consists of rubbing down or coloring the wall as with tuck pointing and making a similar raised false joint, little attempt being made to follow the real joints, the false joint often running across the face of the brick itself. Tuck pointing is fortunately done very rarely. From an artistic viewpoint the effect is not good.

PART III

UNIT IX

BRICKLAYING

1. Methods.—To be truly efficient, the bricklayer should work with the fewest possible motions. This requires study upon his part to determine just which motions are unnecessary. A bricklayer may work twice as hard as he really needs to lay a given number of brick. Each motion should have a definite purpose and should accomplish a definite result. It is not only necessary to learn how to lay a brick correctly and to have the right quantity of mortar both under and against it, but it is also essential to know how to do it the easiest way, without wasting energy. Every bricklayer will develop methods of his own for working to best advantage upon the job. The difference between workers in height, length of arm, strength, and natural quickness of action will influence the handling of the trowel and the laying of brick. Many systems have been devised for aiding the bricklayer in working to best advantage; none has been universally accepted.

2. Using the Mortar Board.—All mortar boards should be wet down before mortar is placed upon them to prevent the wood from absorbing the moisture from the mortar, thus causing it to dry out too quickly. The mortar should be kept turned up in the middle of the board, leaving the outer edges clean. If it is spread out in a thin layer over the entire board, it will dry out quickly, be hard to spread, and will prevent the picking up of a trowelful. The mortar should be kept well tempered at all times, that is, of the proper working consistency. Have the mortar board placed where it is most convenient so that it may be reached with the shortest possible motion. Always pick up mortar from the outer edge of the mortar pile and from the part of the board nearest the worker.

The board should be kept well supplied at all times. Some contractors find it economical to hire a mortar tender to keep the mortar tempered.

FIG. 104.—The proper way to fill a mortar board.

3. Holding the Trowel.—The trowel should be held firmly, yet not tightly, fully grasped with the right hand and con-

FIG. 105.—Correct way of holding trowel. Handle between thumb and forefinger.

trolled by the muscles of the fingers, wrist, and arm, so that it may be rolled between the thumb and the forefinger to any desired position. The holding of the trowel is comparable

to the holding of a razor. The thumb should not go around the handle but should rest on top of it, the first two fingers bearing most of the weight of the trowel. The shank and ferrule should be kept out of the mortar while working because the contact of the forefinger with the mortar will hinder the worker and cause sore fingers. Some bricklayers find it convenient to hold the trowel between the third and the fourth fingers with the blade away from the body, and pick up brick with the thumb and first and second fingers when necessary.

FIG. 106.—Wrong way of holding trowel. The thumb should never encircle it.

4. Picking Up Mortar.—Pick up a trowel full of mortar each time but do not overload it as this will cause the mortar to spill and make the scaffold and wall dirty. Take enough to bed from three to five brick at a time. Lean over only as far as is necessary in order to pick the mortar up with a practically straight arm. Lift the mortar in as straight a line as possible to the place where it is to be spread on the wall, and make the force of its lifting help in throwing it. Use a straight-arm swinging motion in picking up the mortar from the edge of the mortar pile, thus not spreading the mortar over the mortar board and causing it to dry out. Zigzag interrupted motions should be avoided; they waste time and strength. The young apprentice should not be too ambitious in the amount

FIG. 107.—Proper way of picking up mortar. Note the full trowel.

FIG. 108.—Ready to spread mortar. Arm is not held too rigidly.

of mortar he attempts to throw at the start; throwing enough mortar for one brick is sufficient for the first attempts. Don't play with or roll the mortar before picking it up; it is waste motion and tires the worker unnecessarily.

FIG. 109.—Starting to spread mortar. Arm is slightly bent and fingers begin to loosen as weight on trowel grows less.

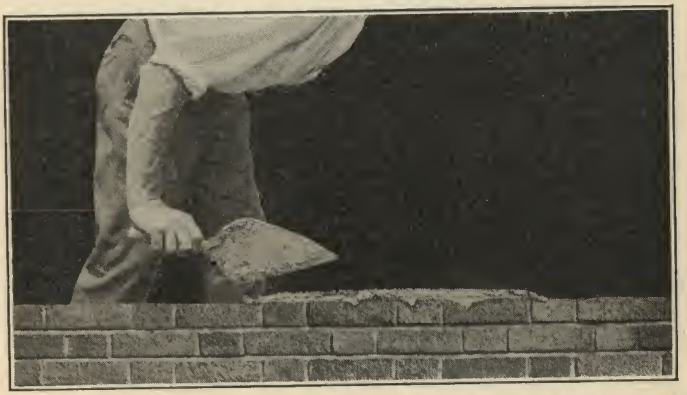


FIG. 110.—The mortar has been spread by a smooth swing of the arm, and the fingers have relaxed. Trowel is now held between thumb and forefinger.

5. Spreading Mortar.—A skillful bricklayer is usually able to throw mortar for three to five brick at one time. If skillfully thrown, little further spreading is necessary and should be accomplished in as few motions as possible.

6. When spreading mortar, the wrist and the shoulder joint should be kept flexible so that the angle of the trowel may be kept constant throughout the swing of the arm. Do

FIG. 111.—Furrowing mortar.

FIG. 112.—Cutting off mortar.

not work with a stiff, jerky motion but with a smooth sweep of the arm and trowel.

7. For right-handed persons, spreading is usually done from left to right. All joints should be of the same thickness except for irregularities in the brick itself. The bricklayer should learn to judge the thickness of bed necessary for the

width of the joint that he is to make and according to the type of vertical joint he is to use, whether shoved, grouted, open, or buttered. Should he find much tapping necessary due to his mortar being stiff, rather than attempt too much tapping in order to bring his brick down to the line the mortar may be leveled by a wavy motion of the wrist known as "furrowing."

8. Cutting Off Mortar.—After spreading the mortar, it should be cut with the edge of the trowel even with the face

FIG. 113.—Tapping brick into place.

of the wall before the brick is laid so that the mortar will not run down the face of the brickwork. After the brick is bedded, the mortar is again cut off and used for buttering the next end joint. In returning surplus mortar to the board, throw it to the back of the mortar board so that the tender may turn it over or retemper it if necessary; a lump of mortar stiffer than the rest will delay the worker.

9. Wetting Brick.—The setting of mortar depends to a large degree upon the amount of water contained in it, dry brick will absorb this moisture before the mortar has set. It is therefore necessary to wet the brick before laying them.

Wetting the brick also cleanses them of dust and dirt, thus giving a better surface for the mortar. In damp weather this wetting is unnecessary. In freezing weather it should never be done, as the water will form a film of ice upon the surface of the brick, preventing the mortar from penetrating into the pores and securing a hold. Too much wetting is to be avoided, as the water, diluting the mortar, will cause the brick to slip on the bed, preventing a good mechanical job and allowing the soft mortar to run down the face of the wall, ruining its appearance. When a brick slips, do not attempt to hammer it back into place until the mortar becomes stiffer, as it will make the mortar even softer and throw the courses out of line. Impervious brick such as paving brick should never be wet for they will absorb little moisture. Water hinders the mortar from getting a hold upon such brick.

10. Picking Up Brick.—Very few brick are exactly alike on all surfaces. The handling, molding, or cutting of the clay, stacking it in the kiln, and the firing process usually produce a brick with one surface better suited to laying to the weather than the other. This surface is usually considered to be the face of the brick, and the surface that comes out the least perfect due to faults of manufacture is considered to be the "cull" surface of the brick, although some architects prefer the cull side be exposed in certain classes of work. Brickwork so laid has a rough and artistic appearance. With face brick, the face surface is usually self-evident, due to its special treatment.

11. Under ordinary conditions the harder surface of the brick should be laid to the weather. A brick with a damaged face may frequently be used as a header when the end is not damaged.

12. In lifting a brick from a scaffold, it is usually grasped with the left hand with the thumb upon one side and the fingers upon the other, the bending point of the fingers coming at the second joint and of the thumb at the first joint. The nearest brick on the scaffold should always be picked up first. Plenty of brick should be available, neatly piled in a convenient location, leaving the bricklayer ample foot room in order that

he may work to best advantage. The brick tender's time is less valuable than that of the bricklayer. He should not be allowed to dump his brick upon the scaffold in such a way that they break, chip, or scatter. Broken brick or bats should be used on the job wherever possible.

13. Laying Brick.—The "spreading mortar," "pick and dip," and "buttering" methods of laying brick should all be learned by the apprentice. The choice of method is always determined by the nature of the job.

FIG. 114.—A neat scaffold.

14. Spreading or Stringing Mortar Method.—For this method a large trowel is used and enough mortar is spread on the wall at one time to lay from three to five brick. In this case, the brick will be picked up after the mortar has been spread on the wall. If the end joints are open or grouted, two brick may be lifted, one in each hand, brought together end to end while in passage from the scaffold to the wall, and laid at one time. If the joint is a shoved joint, they may be bedded in the mortar in different tiers at the same time. In laying

the outside tier, a brick at a time is shoved into place. The bricklayer frequently lifts several brick at a time, placing them upon the backing until needed when working on the face of the wall. This is sometimes called "hacking" When working upon the backing, he places them upon the face tier.

15. Pick and Dip Method.—By this method the brick and mortar are picked up at the same time. The mortar is in a tub or mortar box. In reaching for mortar and brick at the same time, the location of the mortar can be spotted while moving down to it, but to pick up the brick quickly requires the attention of the eye, the mortar being picked up by the "feel."

16. Buttering Method.—It used to be the custom a few years ago to face buildings with pressed brick—each brick mechanically perfect, with absolutely square edges, and every brick matching perfectly in color—no variation whatever being allowed. Such brick were generally set with a very thin joint, known as a "buttered" joint. This joint is formed by holding the brick to be laid in the left hand, and buttering it with the trowel held in the right hand. The mortar is gathered on the bottom of the trowel, and the brick is buttered all around the four sides of its bed and of that vertical side which will afterward be in contact with the brick previously laid. The brick with the mortar adhering to it is then shoved into place. This is a slow method of laying brick, only employed where the joints are very thin.

17. Shoved Joints.—In making a shoved joint, a bed of mortar is spread, thicker than the joint will be when finished. In laying the brick, it is pressed into this bed, downward and toward the brick which it is to join. The soft mortar will rise and fill the vertical joints. Shoved joints are frequently specified for solid walls and piers. In cases where the wall will be exposed to the weather, the outer tier should always be laid with shoved joints.

18. Grouted Joints.—Grouting is a method of filling all the vertical joints in a wall with thin mortar, or grout. The outer and inner tiers are first laid with shoved joints. The core of the wall is bedded in a full bed of mortar but the vertical joints

are filled after the bricks in the course are laid, the thickness of a joint apart, by grouting. The quickest way to grout brickwork is to take a dipper of water with the left hand and a trowel full of mortar with the right, just enough water being added to thin the mortar after it has been spread, and the mixture being worked in between the joints with the trowel until the joints are completely filled.

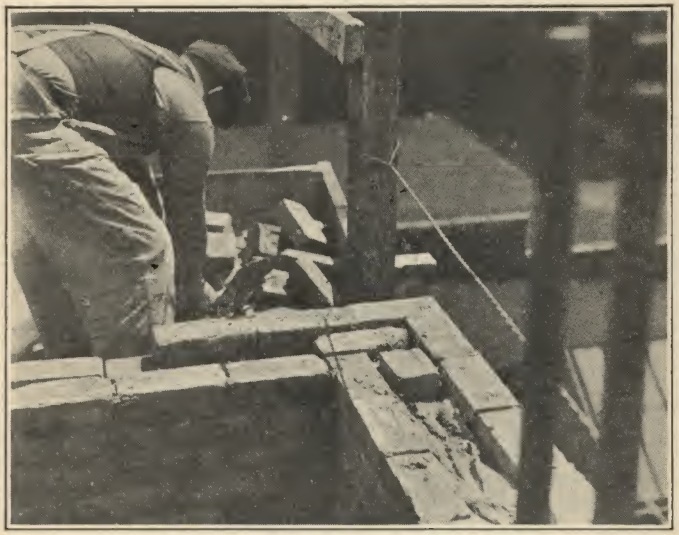


FIG. 115.—Building a wall by the grouting method. Inner and outer tiers are first laid with shoved joints.

19. Slushed Joints.—In slushed joints the mortar is spread upon the wall as in grouting but is thin enough to run down into and fill the vertical joints without the addition of water. The inside tier and the core of a wall over 8 in. thick are laid upon a full bed of mortar, the brick being placed the width of a joint apart, and all joints slushed. The brick in the outer tier are shoved. Never slush up a wall when paving brick is used, as the soft mortar will cause the brick to settle, due to its excessive weight and its impervious nature.

20. Open Joints.—In many cases where work is above grade the wall is laid with a full bed of mortar with the vertical joints

in the backing left open, the joints in the outer tier being shoved. In such cases, frequent header course with full joints should be laid. It is claimed that a wall of this type is practically as strong as any other wall.

21. Dry Joints.—In some jobs every sixth course upon the interior of the wall is laid without mortar. A lath is sometimes inserted. This weakens the wall but permits the nailing of furring, door frames, etc. into the dry joint. This is not good practice and in many cities would not be allowed under the building code.

22. Filled Joints.—For all party, fire, and division walls carrying heavy loads the brickwork should be laid solid with all joints full of mortar. In building chimneys, it is essential that the ends of the flue tile, the space between the flue tile and the surrounding brickwork, and the joints in the surrounding brickwork itself must be full of mortar.

23. Roll.—As the top edge of the brick is always laid to the line, it is this edge which should be the most prominent upon the face of the wall so that one looking up from the ground will see the upper edges projecting slightly beyond the lower edges of the brick, forming a series of parallel lines for each course. This tends to hide any irregularities on the face of the brick, giving the entire wall the appearance of careful and accurate workmanship. In order to accomplish this, it is necessary to give the brick a slight "roll," that is, to slope the brick so as to bring the bottom edge slightly in from the line of the wall.

24. In giving a roll to their work, bricklayers sometimes through carelessness throw the wall out of plumb, causing the entire wall to slope in as it goes up. This is called "battering." The opposite of this, or having the wall slope outwards as it goes up, is known as "overhang."

25. Some brick are wider upon one side than the other, due to the slight batter of the vertical surfaces of the molds to permit the removal of the brick. In this case, the brick may be laid flat, if the wider side is laid at the top, automatically producing the desired result. Other brick have both the face and the cull surfaces parallel but sloping at a slight angle

from the sides. The brick may be laid flat but with the face so placed that the upper edge projects beyond the lower edge.

26. Some bricklayers claim that they can tell by the feel of the brick the proper side to select for the top and turn the brick to the right position while it is in motion from the scaffold to the wall, doing this almost unconsciously from practice.

27. Setting the Line.—In order to have a neat job, the horizontal joints should be parallel to each other. This is accomplished by laying the outside tier of each course of brick to the line. The line should be as fine as is obtainable of strong cord of the best grade. It should be stretched tightly between the corners and fastened by wire nails, flattened at the end when used with close joints so that they will fit in the vertical joints of the face of the wall; or a square nail without too sharp an edge, the latter being more practical than a wire nail under most conditions, particularly if used on the pull end of the line. If the line is so long that there is danger of its sagging, it must be held up in the center by a "trig" (Fig. 32, p. 45), which should never be made fast to the line but should be in the form of a loop so that the line may be drawn through it with ease. A broken line should be spliced rather than knotted, as the knot throws it out from the wall, and moreover the loose ends of the knot have an aggravating way of getting into the mortar. Should a knot be necessary, it should be as small as possible. A new line will save much time and temper. The corners or leads are built up first by the most experienced bricklayers and carefully plumbed by the use of the spirit level and plumb rule. The line should be stretched between these two corners and raised only one course at a time. Leads are usually not carried more than a header ahead of the work, otherwise the wall is liable to be irregular. While the courses are being laid between headers, the leads may be carried up to the next header course. The trig should not be carried more than two courses over the line and should be sighted both for height and for "in and out" with the corner courses. Care must be taken to fasten the line to courses of the same height at the corners, otherwise a slope or "hog" will result in the courses.

28. Laying to the Line.—Brick should never be laid hard to the line, that is, against it, but the top edge of the brick should come approximately $\frac{1}{16}$ in. behind it. "Crowding the line"

FIG. 116.—Fingers being raised to avoid touching the line.

throws the line out of position, tending to make a bulging wall and preventing the workers from doing a good job. In

FIG. 117.—Brick properly laid to the line.

spreading the mortar the trowel should not touch the line. In laying the brick, as the fingers come toward the line, a habit should be formed of lifting them so that they will come

up as the brick goes down. If the thumb comes near the line, the thumb should be lifted as the brick goes down. A brick should be squeezed to the line and not hammered into place with the trowel.

29. Raising a Corner Lead.—As the corner, or lead, is the first portion of the wall to be laid, it will determine the width of the mortar joint both horizontally and vertically, for the rest of the wall. Trial courses are frequently laid without mortar to secure correct measurements. The architect's drawings and specifications will usually define the length of the wall, the bond and the joint. A slight variation in the width of an end joint will enable the bricklayer to make his bonds come out right, thus making closers unnecessary except those required at corners to complete the bond. The number of courses necessary to come to sill height, window head height, story height, or any other height are sometimes marked off upon the edge of a length of 1- by 2-in. strip. This is frequently called a "story pole." The spirit level should be used for leveling the wall horizontally and as a straight edge on the face of the wall. After the first few courses are laid the wall may be plumbed vertically. The lead should not, as a rule, be extended too far (tailed out) from the corner. Four feet is a reasonable distance. The man on the corner should have a start upon the other bricklayers and may back up his part of the wall while the men on the wall are building up to him. He should measure his courses frequently in order to secure the correct thickness of joint. When a course does not come out right, it is sometimes better to use two three-quarter brick than a whole brick as it will not be so evident. If a closer is necessary, a bat and a three-quarter may be used. This condition will not arise if the job is laid out right at the start, if the brick has not varied too much in size, and if the bricklayer has not varied his joint too much.

30. Sighting.—The bricklayer "sights" with his eye to get his corners plumb and corrects his errors by means of a plumb rule. The first few courses must be plumbed by the use of the plumb rule in order to have some guide for sighting the courses to follow. Only one face of the wall should be sighted at a

time. If both faces of the wall are plumb the corner will of necessity be plumb. Careful sighting will prevent many a poor job. This applies to the tops of window frames and the tops of sills and piers. The habit of sighting will be acquired by the bricklayer through practice.

31. In bricklaying, as in but few other crafts, the development of cleverness and skill in the use of the eye in accurately estimating spaces and distances and the habit of doing the job right the first time are essentials of good workmanship; and will distinguish the first-class craftsman whose work will be a source of just pride to himself and pleasure to all who will afterward view the building.

FIG. 118.—Plumbing a corner.

32. Plumbing a Corner.—In using a plumb rule for plumbing a corner, both sides of the corner must be plumbed, the rule held vertically against the wall close to the corner itself, and used in this manner on both sides of the wall.

33. Cutting and Clipping Brick.—The bricklayer's chisel, bolster, or set, is necessary to cut brick to an exact line. If the edge is ground to approximately 60 deg. with the straight side, the break will come in line with the straight side of the

chisel. If the chisel is tilted a little away from the one cutting, the break will slope slightly in. This will give the brick just enough clearance to prevent the necessity of having to trim the brick further. When using the bolster, it should be held loosely in the left hand to prevent skinning the hand. The straight side of the bolster should face the part of the brick to be saved, as well as facing the worker doing cutting. One blow of the hammer should be sufficient to cut the brick. With hard brick, the brick may be fractured roughly by

FIG. 119.—Cutting brick with bolster.

a blow with the head of the hammer, leaving sufficient brick for accurate cutting with the set. If the set does not break the brick, a light tap with the head of the hammer upon the side where the fracture will come will split the brick. In holding the brick set with the left hand, form the habit of pushing the hand and set quickly away from the brick at the instant of the blow so that when the brick fractures, the hand will not be hurt.

34. For ordinary work, the bricklayer's hammer may be used for cutting and clipping brick, the brick to be held in the

left hand while the hammer is held in the right. The head should always be used for making the break and the chisel peen used for cutting off the irregular places left at the fracture.

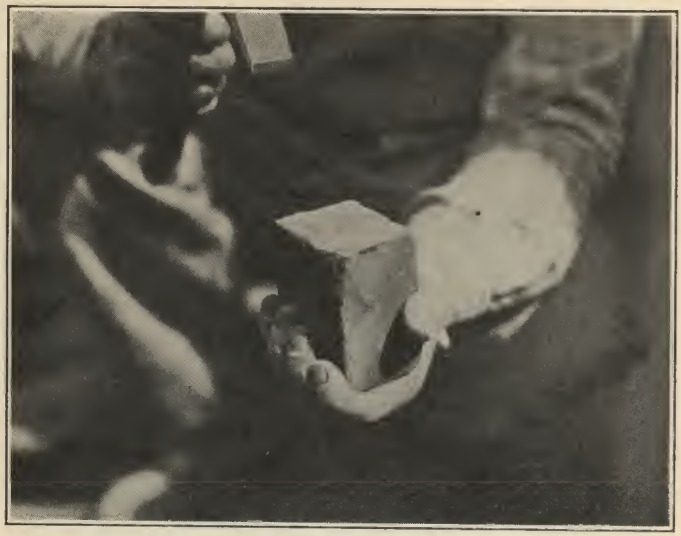


FIG. 120.—Cutting off rough edges with chisel peen.

In using the hammer for cutting, it is tilted just enough for the sharp edge of the head of the hammer to hit the brick.

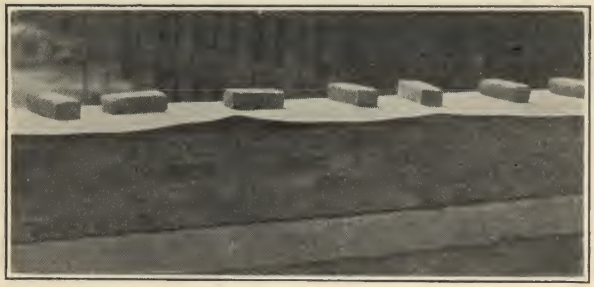


FIG. 121.—Protecting work for the night.

When the brick is not too hard it may be split by a sharp blow with the side of the trowel. Extremely hard brick is liable to break the trowel.

35. Covering the Wall.—Before quitting for the night the exposed courses should be covered with boards projecting 1 to 2 in. from the face of the wall to protect them from rain, sleet, or snow. If they are to be left exposed for a long time, they should be covered with tar paper or with a tarpaulin. Boards should have brick piled on them to keep them from blowing away, or they may have short vertical pieces of board nailed to them and allowed to hang pendulum-wise on each side of the wall.

36. Keeping a Clean Wall.—Keep the wall clean. Never leave a job without cleaning up mortar ends. Soft mortar is more easily removed than hard mortar.

37. Laying Fire Brick.—The chief factor in laying fire brick where they will be exposed to extreme heat, as in lining furnaces, is to have close joints. They should be kept in a dry place up to the time they are needed. The brick should be dipped in a mortar made of fire clay and water so that the bottom surface and the sides will be covered, and tapped firmly into place with a bricklayer's hammer. The trowel is not used except for pointing. The brick should fit as tightly as if the fire clay were not there and the brick were simply stacked. In cutting fire brick always make perfect cuts whether the cut will be visible or not. Perfect joints are necessary to prevent the flame from creeping through. Never subject the work to heat until the job is thoroughly dry. The best grade of fire clay should be used and is sometimes made by regrinding used fire brick. A mortar known as ganister is made by mixing an aggregate of ground fire brick with fire clay in order to give it body. This is used largely for patch work and is not considered good practice for new work. Special high-temperature cements are manufactured and are sometimes used for plastering the inside of the furnace.

38. No mortar is used for laying silica brick. Care is taken to fit the brick so that the joints will fuse together and the bond used is such that no end joint opening extends completely through the wall.

39. A slight amount of silica sand is used to fill all irregularities between the brick. Silica brick should never be wet.

40. In laying fire brick a thin wedge of brick is known as a "feather edge"; a brick cut in two with a break parallel to the side is called a "split"; and a brick cut lengthwise parallel to the face is called a "sope," the latter being called a "queen closer" in ordinary brickwork. End wedges and side arches are special fire brick for arch work. A bond frequently used in laying fire brick is made up of five courses of headers with one of stretchers. The fire brick wall should be at least 8 in. thick wherever the flame strikes it except in places where there is no great heat.

41. Laying Impervious Brick in a Wall.—Paving brick are sometimes used in a wall but, due to their greater weight, tend to squeeze out a slow-setting, soft mortar. It is therefore necessary to use care in laying them and to use cement or cement-lime mortar. As they are practically impervious, they do not adhere to the mortar readily. For this reason the brick should never be wet at the time of laying. This is true of any impervious brick. Do not tip or move an impervious brick after laying, as this may soften the mortar and throw the work out of plumb.

UNIT X–A

MISCELLANEOUS CONSTRUCTION ELEMENTS

1. Foundations and Footings.—The foundation of a building includes all those parts which are below the superstructure and grade. The first essential of a good foundation is solid ground. The excavation should be carried to a depth where the ground is firm enough to bear the weight of the footing.

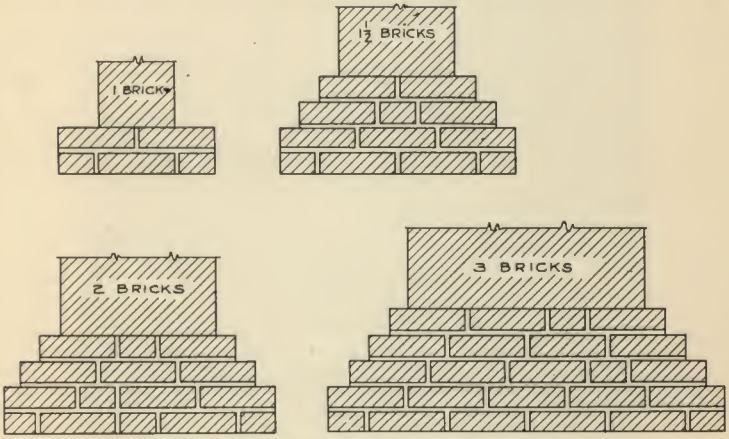


FIG. 122.—Footings with brick laid flat.

Every footing should be below the frost line or it will be heaved up in winter by the expansion of the moisture in the ground when it freezes. The first courses are known as the footing of the building and should be of such width that the soil beneath should not be required to carry a load in excess of its capacity. It is recommended by The Common Brick Manufacturers' Association that projecting courses of footings be laid with brick on edge, as courses laid in this manner are much stronger than courses laid flat. The common practice, however, has

been to lay the brick flat. Two inches should be the maximum projection of one course beyond the one immediately above it. Where the projection is one course deep, all the brick forming the projection should be headers. If two courses deep, the top course should be all headers and the lower one stretchers. If the footings are constructed of brick laid flat, the first two courses should be of the same width and each succeeding course

FIG. 123.—Twelve inch Ideal foundation wall of apartment house, on footings laid with brick on edge.

should be decreased on both sides by a distance of 2 in. until the width of the wall is reached. All bed joints should be filled with mortar. To produce the most economical type of brick footing for buildings carrying only moderate loads, mortar is sometimes used in the bed joints only, the brick being rapidly laid upon the full bed joint with no mortar between them. In many buildings a concrete footing is poured

in an excavated trench, the bricklayer starting the wall at its final thickness directly from the concrete.

2. Residences with 12-in. basement walls, when built on solid ground, usually need no footings, the 12-in.-wide bearing being sufficient to support the load. In locations where stone is plentiful the footings and foundation walls are sometimes built of this material.

3. Local building ordinances specify the minimum thickness of walls which may be used for various types of construction. Many building ordinances require walls of excessive thickness for residences. A model building code has been published by the United States Government.[1] This code defines the minimum thickness of brick residence walls as follows: Where such walls are not over 30 ft. high above the first floor line, the basement wall may safely be 12 in. thick and the wall above 8 in. thick. Five feet additional height is allowed for gables.

4. Underpinning.—The installing of supporting masonry under a wall already built, while the old wall is temporarily supported on jacks or "needles" of steel or timber, is called underpinning. The new brickwork should meet the old brickwork and the last course should be wedged in so tightly that there will be no settling of the old wall. Thin sheets of slate or steel wedges are frequently used as "shims." It is a safer practice to lay the last course with brick cut wedge shape, top and bottom, the cavity being filled with mortar, and the brick driven home in such a manner that the mortar is forced out around it.

5. Moisture-proofing Walls.—There are several methods of making basement walls moisture-proof. One method is to plaster the outer surface of the wall with a mixture of one of cement to two of coarse sand, and coating the whole with asphalt after the cement has set. The asphalt is often applied directly to the brick, the wall being laid preferably with struck

[1] "Recommended Minimum Requirements for Small House Construction." Sent for 15 cents in coin or money order (not stamps) upon application to the Superintendent of Documents, Government Printing Office, Washington, D. C. A code for larger buildings is now being prepared.

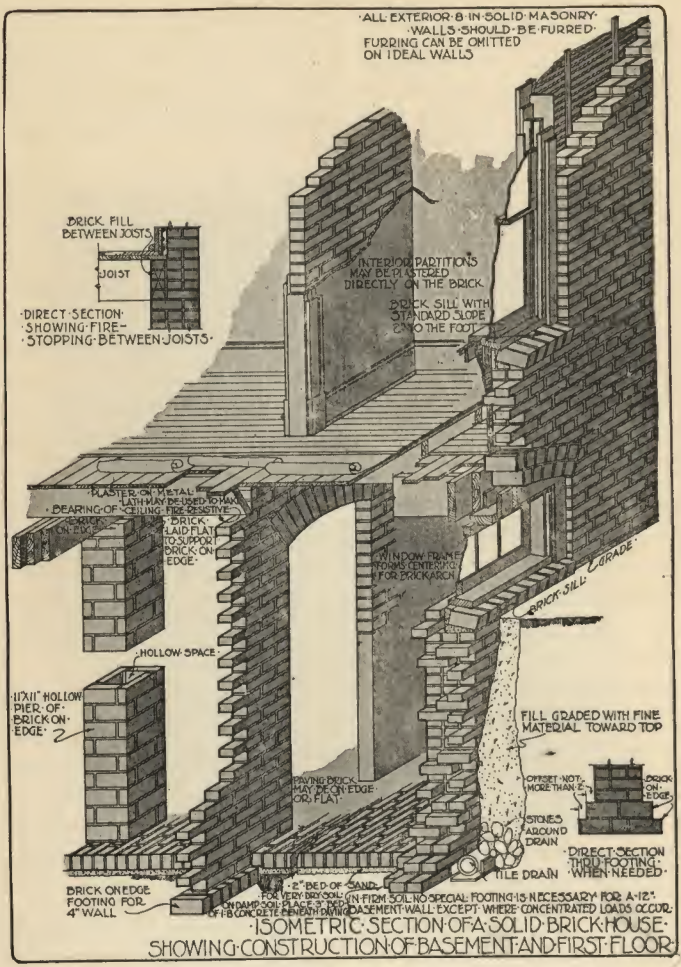

ALL EXTERIOR 8 IN SOLID MASONRY WALLS SHOULD BE FURRED FURRING CAN BE OMITTED ON IDEAL WALLS
BRICK FILL BETWEEN JOISTS
JOIST
DIRECT SECTION SHOWING FIRE-STOPPING BETWEEN JOISTS
INTERIOR PARTITIONS MAY BE PLASTERED DIRECTLY ON THE BRICK
BRICK SILL WITH STANDARD SLOPE AND TOOLED
PLASTER ON METAL LATH MAY BE USED TO MAKE BEARING OF CEILING FIRE RESISTIVE
BRICK LAID FLAT TO SUPPORT BRICK ON EDGE
WINDOW FRAME TO BE SET CENTRALLY FOR BRICK ARCH
BRICK SILL
GRADE
HOLLOW SPACE
11"X11" HOLLOW PIER OF BRICK ON EDGE
FILL GRADED WITH FINE MATERIAL TOWARD TOP
PAVING BRICK MAY BE ON EDGE OR FLAT
OFFSET NOT MORE THAN 2"
BRICK ON EDGE
STONES AROUND DRAIN
DIRECT SECTION THRU FOOTING WHEN NEEDED
TILE DRAIN
BRICK ON EDGE FOOTING FOR 4" WALL
2" BED OF SAND FOR VERY DRY SOIL
IN DAMP SOIL PLACE 3" IMPERVIOUS CONCRETE BENEATH FOOTING
IN FIRM SOIL NO SPECIAL FOOTING IS NECESSARY FOR A 12" BASEMENT WALL EXCEPT WHERE CONCENTRATED LOADS OCCUR
ISOMETRIC SECTION OF A SOLID BRICK HOUSE SHOWING CONSTRUCTION OF BASEMENT AND FIRST FLOOR

PLATE IV.

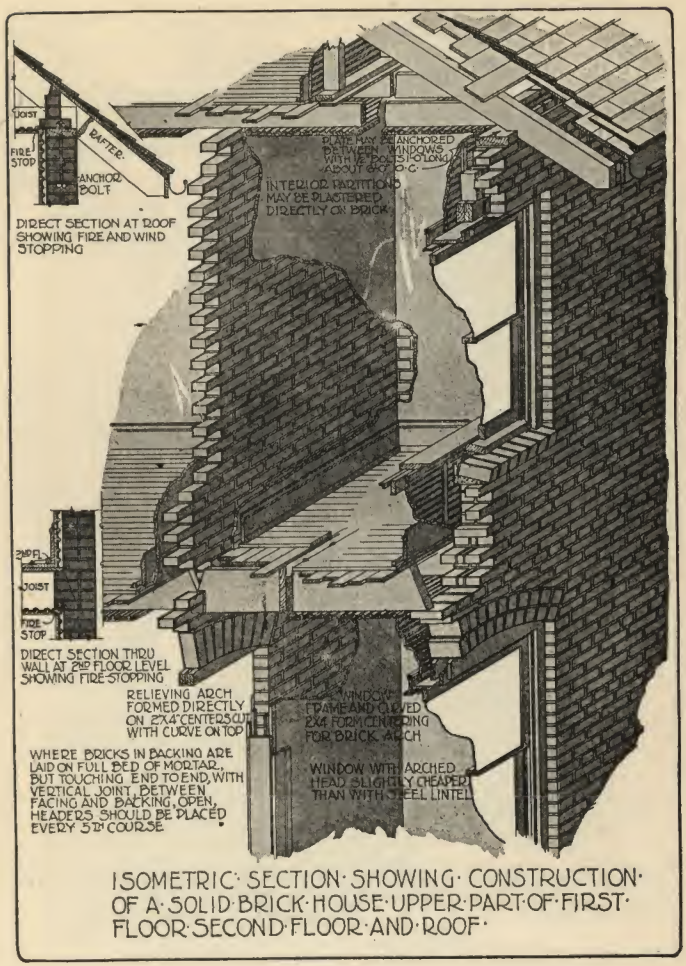

JOIST
FIRE STOP
RAFTER
ANCHOR BOLT
DIRECT SECTION AT ROOF SHOWING FIRE AND WIND STOPPING
PLATE MAY BE ANCHORED BETWEEN WINDOWS WITH ½" BOLTS 10" LONG ABOUT 6'0" O.C.
INTERIOR PARTITIONS MAY BE PLASTERED DIRECTLY ON BRICK
2ND FL. JOIST
FIRE STOP
DIRECT SECTION THRU WALL AT 2ND FLOOR LEVEL SHOWING FIRE STOPPING
RELIEVING ARCH FORMED DIRECTLY ON 2"X4" CENTERS CUT WITH CURVE ON TOP
WINDOW FRAME AND GROOVED 2X4 FORM CENTERING FOR BRICK ARCH
WHERE BRICKS IN BACKING ARE LAID ON FULL BED OF MORTAR, BUT TOUCHING END TO END, WITH VERTICAL JOINT BETWEEN FACING AND BACKING, OPEN, HEADERS SHOULD BE PLACED EVERY 5TH COURSE
WINDOW WITH ARCHED HEAD SLIGHTLY CHEAPER THAN WITH STEEL LINTEL
ISOMETRIC SECTION SHOWING CONSTRUCTION OF A SOLID BRICK HOUSE UPPER PART OF FIRST FLOOR SECOND FLOOR AND ROOF

PLATE V.

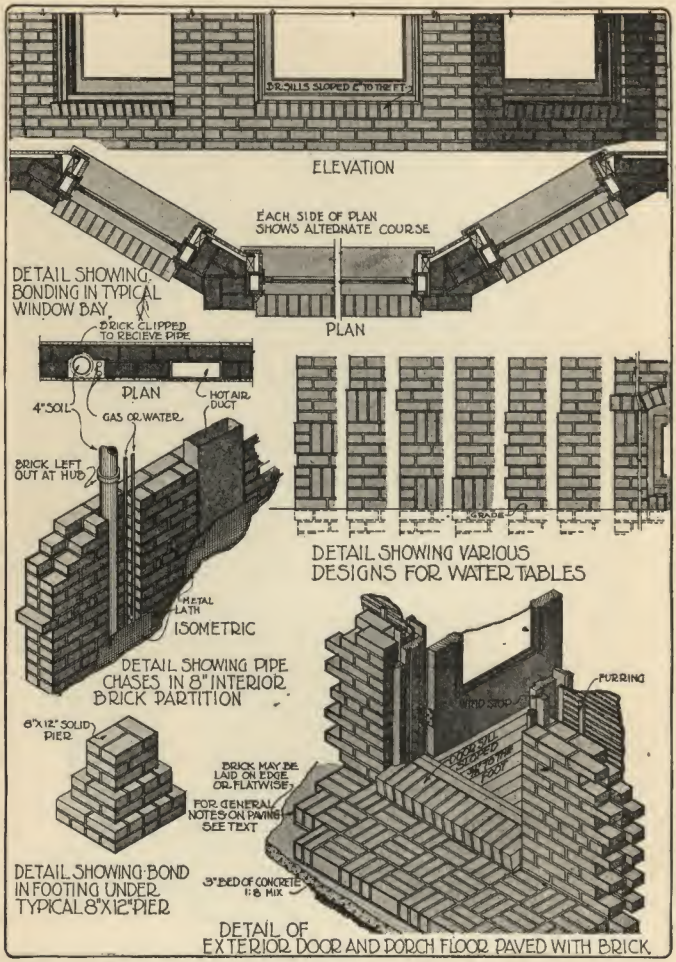

DR. SILLS SLOPED ¼" TO THE FT.
ELEVATION
EACH SIDE OF PLAN SHOWS ALTERNATE COURSE
DETAIL SHOWING BONDING IN TYPICAL WINDOW BAY
PLAN
BRICK CLIPPED TO RECIEVE PIPE
PLAN
4" SOIL
GAS OR WATER
HOT AIR DUCT
BRICK LEFT OUT AT HUB
GRADE
DETAIL SHOWING VARIOUS DESIGNS FOR WATER TABLES
METAL LATH
ISOMETRIC
DETAIL SHOWING PIPE CHASES IN 8" INTERIOR BRICK PARTITION
8"X12" SOLID PIER
BRICK MAY BE LAID ON EDGE OR FLATWISE
FOR GENERAL NOTES ON PAVING SEE TEXT
3" BED OF CONCRETE 1:3 MIX
DETAIL SHOWING BOND IN FOOTING UNDER TYPICAL 8"X12" PIER
FURRING
DETAIL OF EXTERIOR DOOR AND PORCH FLOOR PAVED WITH BRICK

PLATE VI.

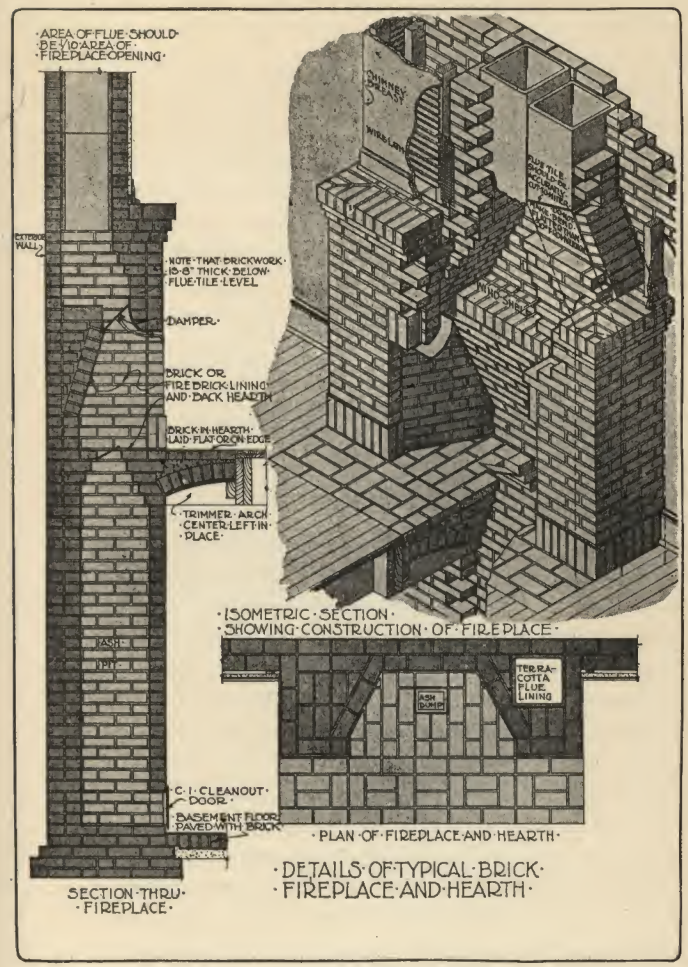

AREA OF FLUE SHOULD BE ½ AREA OF FIREPLACE OPENING
CHIMNEY BREAST
WIRE LATH
FLUE TILE
EXTERIOR WALL
NOTE THAT BRICKWORK IS 8" THICK BELOW FLUE TILE LEVEL
DAMPER
BRICK OR FIRE BRICK LINING AND BACK HEARTH
BRICK IN HEARTH LAID FLAT OR ON EDGE
TRIMMER ARCH CENTER LEFT IN PLACE
ASH PIT
C. I. CLEANOUT DOOR
BASEMENT FLOOR PAVED WITH BRICK
SECTION THRU FIREPLACE
ISOMETRIC SECTION SHOWING CONSTRUCTION OF FIREPLACE
TERRA-COTTA FLUE LINING
ASH DUMP
PLAN OF FIREPLACE AND HEARTH
DETAILS OF TYPICAL BRICK FIREPLACE AND HEARTH

PLATE VII.

joints. Tar is sometimes substituted for asphalt but has a tendency to become brittle and chip off. A mixture consisting of one part pitch to three parts of tar is frequently used as it is less expensive than a pure asphalt coating and will adhere to the wall. In very wet soils alternate layers of felt and hot asphalt called membrane waterproofing are built up on the outside of the wall and a layer of asphalt roofing is inserted between courses just above grade to avoid all possibility of moisture creeping up the wall. In some dry soils waterproofing is not necessary if tile drains are properly laid about the foundation.

6. Piers.—A pier is an isolated support, constructed of masonry, usually supporting an arch, beam, or steel girder. The size and the construction of piers will be determined by the nature of the job, its height, the load to be carried, and local building ordinances. Tests have proved that hollow piers built of brick on edge will support great loads (see "Brick —How to Build and Estimate").

7. Pilaster.—Architecturally, a pilaster is a flat vertical column, structurally a part of or attached to the face of a wall, and is used either behind a column or independently. In trade practice a pilaster is any vertical thickening of the wall, structurally resembling a portion of a pier, serving as a reinforcement or support at any required point.

8. Party and Fire Walls.—A wall separating two buildings owned by different people is called a party wall. A vertical wall dividing a building into two or more isolated sections is called a fire wall. These walls should always be of solid masonry and should be of sufficient thickness to withstand the complete destruction by fire of the contents of the property on either or both sides of the wall without collapsing from the action of the fire, water, or wreckage. It is desirable that the wall be thick enough to prevent fire spread by the transmission of heat through the wall.

9. Solid brick party walls, because of the small units used in their construction, make the only practical wall for the subsequent insertion of new joists, girders, rafters, etc. and the most

convenient wall for any changes, such as openings, new floor levels, or rebuilding on one side of the wall.

10. Toothing.—In leaving a section of brickwork so that subsequent work can be bonded into it, the end is finished in what is known as "toothing." Toothing is a vertical break in the wall but with alternate courses left projecting a sufficient distance to assure good bond with the portion to be afterward built, this end thus presenting a toothlike appear-

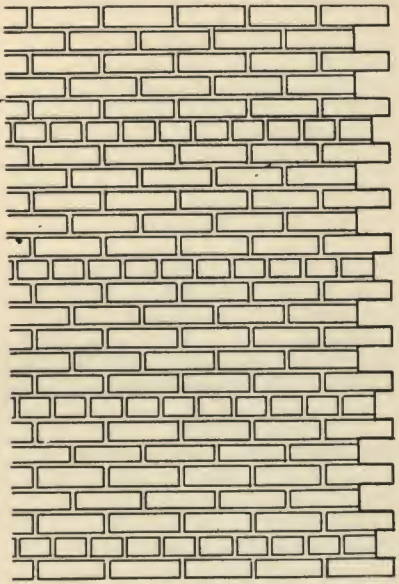


FIG. 124.—Toothing.

ance. Toothing should be avoided wherever possible; it is difficult to construct the new portion so that the whole wall, including the old and new portions, will act as a unit in resisting longitudinal stresses. There is generally a weak point at the toothing. It is very seldom that the joint at which the toothing comes is not evident. Strap iron can be used to help in securing a better bond as described under "Blocking."

11. Filling Toothings.—The best way to fill toothing is to cut the brick to a wedge shape by slightly trimming the upper

and lower surfaces so that the face of the stretcher is left unimpaired, the narrowest point of the wedge being the back corner of the brick at the end to be driven home. The hole

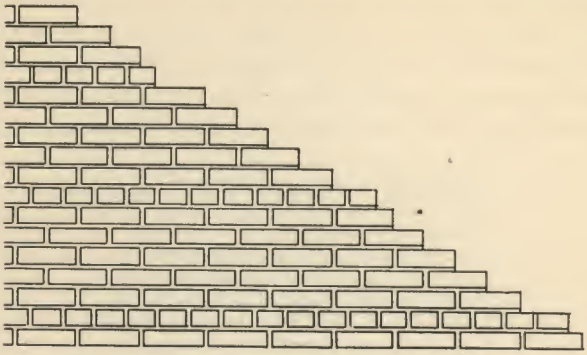


FIG. 125.—Racking.

FIG. 126.—The wall in the foreground has been "racked."

should first be wet and plastered with mortar on all sides. Enough mortar should be placed in the hole to ooze out about the joint when the brick is driven into place. A quicker job

may be made by not cutting the brick and by buttering the joint. This is not considered such good practice as it is hard completely to fill the joint with mortar.

12. Racking.—In raising a corner, the courses end in a series of steps in order that the men on the wall may tie their courses to it in the easiest manner. In other words, each course on the wall will be shorter than the course below it.

13. Blocking.—Blocking is a method of finishing a wall so that subsequent work can be bonded into it by leaving alternate projecting blocks of several courses of brick. Tying new work to blocking makes a much stronger and better job than toothing. To preserve the continuity of the bond, the outer tier may be toothed from the blocks. Ties consisting of strap iron laid in every fourth or fifth course, and bedded about 2 ft. into the portion first built with about 2 ft. left projecting are frequently used to help the bond. This is a good method in any case, particularly valuable when the two walls to be joined are constructed of courses of varying heights.

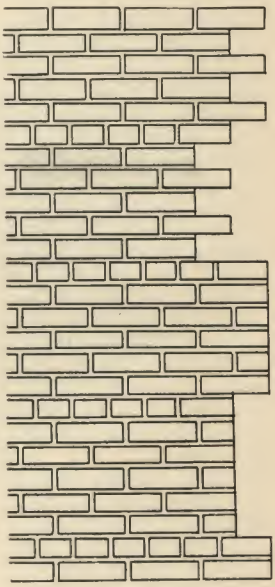


FIG. 127.—Blocking.

14. Adding to the Thickness of a Wall.—A common method of increasing the thickness of an existing wall is to cut out pockets in the old wall every 4 ft. to the depth of one brick for a space equal to the distance between two header courses in height and about 3 ft. long. The hole should be tapered in so that brick will dovetail into the wall. The portion of the new wall adjoining this space should consist entirely of headers with full joints wedged carefully into place. All joints should be full of mortar.

15. A cheaper method of adding to the thickness of a wall is to hold the new wall to the old one by steel bolts with large washers against both the outside and the inside walls. Adding

to the thickness of a wall where the new part is to carry any load is questionable practice; it is difficult to construct a foundation enabling the new part to share its portion of the load.

16. Laying Brick against the Wall of Another Building.—In laying brick against an adjoining building, make as neat

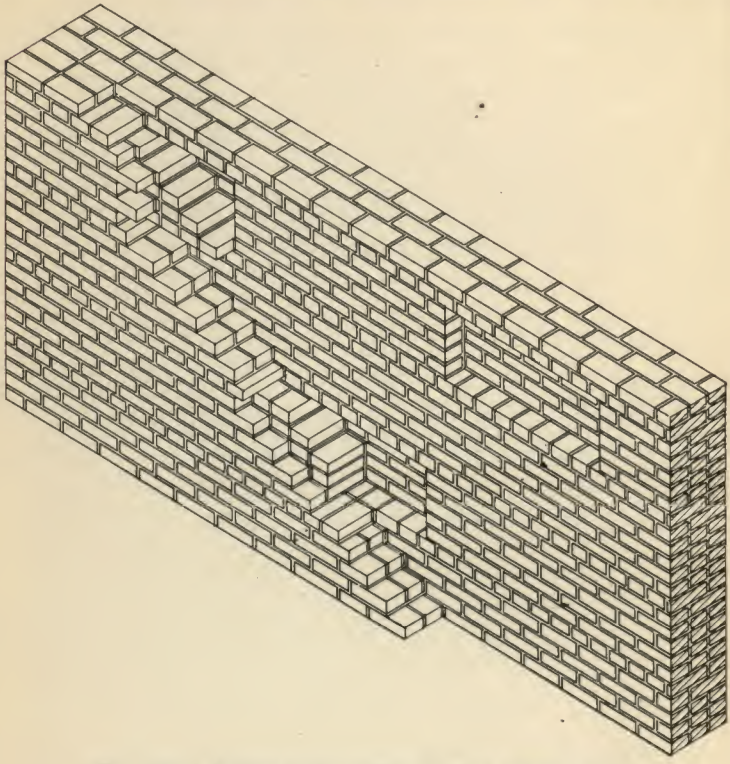


FIG. 128.—Adding to the thickness of an existing wall.

a job as possible on the face of the wall although it is concealed. The adjoining building may be torn down and the work exposed. Never let the wall go over the property line; for if the adjoining owner should discover it, the owner of the building upon which the worker is engaged might be caused much trouble and expense.

17. Fireproof Floors.—For fireproof floors, arches constructed of brick laid on edge between steel I beams and filled in with concrete to level up for the floor above make a strong and permanent job. The I beams are held together by tie rods. I beams should be fireproofed on the bottom flange.

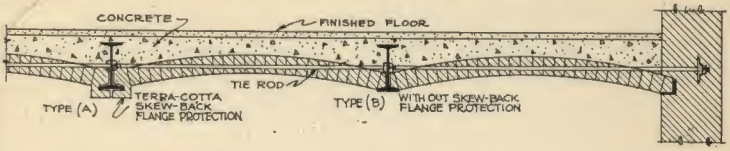


FIG. 129.—Brick floor-arch.

The brick are dry and are laid on centers so that they touch at the soffit, and the joints grouted in. The floor is then built up flush on top with concrete over which a wooden floor may be laid on sleepers.

18. Brick Column Protection.—Steel columns may be protected from fire by being enclosed in brick. A 5-hr. protection rating has been given to a 4-in. thickness of brick used for this purpose. A light porous brick, which it is believed will give equally efficient protection, has recently been placed upon the market.

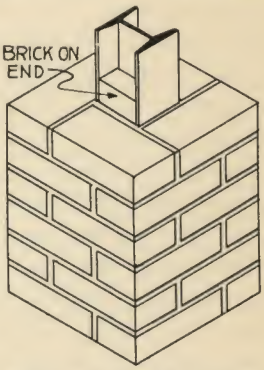


FIG. 130.—Brick column protection.

19. Elevator and Stairway Inclosures.—Elevators, stairways, and other openings extending vertically through the building should be inclosed by a brick wall which should extend above the roof of the building.

20. Pipes and Chases.—Openings such as chimney flues and chases should be provided as the wall goes up. Chases are openings in the wall left for water pipes, electrical and telephone conduits, gas pipes, and other purposes. Conduits are frequently built within the wall as it is erected. Soil pipes not over 4 in. in diameter may be provided for by a 4½-in. chase in 8-in. interior walls only. Provision for the 6-in. hubs may

be made by chipping a place out of the wall at the time the plumber is "roughing in." Other smaller pipes may be run through the same chase wherever it is convenient. Chases are sometimes covered by metal lath and plastered. Where access to pipes is desirable, wood or metal panels are sometimes placed in front of the pipe spaces.

21. Joist Supports.—When wooden joists are tightly inclosed in mortar, dry rot frequently results. By making the openings in the wall slightly larger than the joists and thus allowing a slight circulation of air, this may be avoided. The shrinkage of the joist frequently is sufficient to allow ample ventilation but it is safer to keep the mortar away from the wood. The ends of the joists should be fire cut, that is, cut at an angle that will make the joists longer at the bottom than at the top. This will allow the joists to fall from the wall in case of fire, thus preventing further damage to the masonry. The width of the horizontal joints should be so regulated that the brick supporting the joists will be at the correct level. Joists, girders, and other bearing members should ordinarily bear directly on the brick unless the load they transmit is greater than the supporting brickwork can safely bear without crushing. In the latter case, cast-iron plates or other means must be taken to distribute the load upon a sufficient area of brickwork. Thin wedges, called "shims" for correcting irregularities in the level of the supporting brickwork and keeping the joists to the right level are sometimes used. Wooden shims should never be used as they will shrink. Should shims be necessary, thin pieces of roofing slate should be used, as they will neither crush nor shrink. With careful workmanship shims should not be necessary.

22. Anchors.—Each community has its building ordinance which provides where anchoring is necessary. Under some conditions, it is desirable to anchor roof plates and floor joists to the wall. Roof plate anchors are more commonly required than joist anchors, however, due to the amount of wind stress to which the roof is subjected. The anchor sometimes consists of a half-inch bolt with a large washer on the head built into the wall for several courses before the top is reached. The

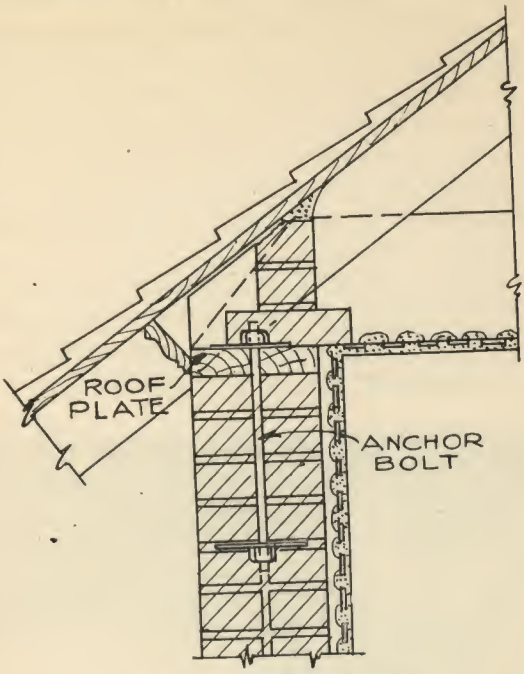


FIG. 131.—Roof plate anchor.

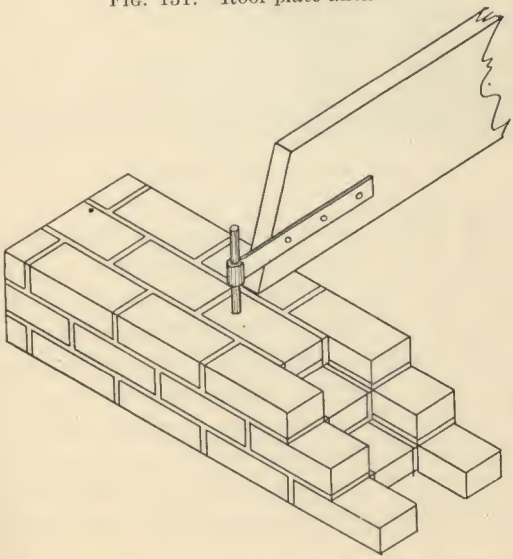


FIG. 132.—A commonly used type of joist anchor.

bolt comes up through the plate which is fastened down by a nut over a washer.

23. Joist anchors, which should be fastened near the bottom of the joists, consist of metal straps fastened to the sides of the joists and bent about steel rods imbedded in the wall. Some anchors are made of metal straps in the form of a T or L. Anchors should come as near to the outside face of the brick wall as possible.

24. The Jamb.—The vertical side of an opening, such as a door or window opening, is called a jamb. The jamb should be carefully plumbed at the ends as well as on the face, to prevent a ragged appearance.

FIG. 133.—Laying a brick sill.

25. Window Sills.—The window sill is the part of the wall supporting the lower edge of the frame and may be a brick rowlock or stone, terra cotta, or cast cement. If the sill has lugs, these should be of such thickness that they will line up with the brick courses. In all cases the sill is sloped to the front so as to shed water. With brick the slope is usually about 2 in. to the foot. Because it must withstand severe weathering, it is best to lay the sill in 1:2 cement mortar with flush buttered joints. Sills should be carefully lined up to secure an even bed for the frame and for good appearance.

Brick sills will look best if they are no wider than the opening in which they are laid and if each brick is carefully selected so as to be of the same size at the exposed end. They should project from the face of the wall from 1 to 2 in. so that water will drip clear of the wall beneath. One-piece sills, especially those with lugs, are set in mortar at the ends only, to protect them from breaking, due to any irregular settling of the building. Short slip sills are sometimes laid on a solid bed. All sills should be carefully laid and the outer edge should be parallel to the face of the wall. Sills are sometimes laid of brick without slope and the slope given by a layer of cement. This is not a good method, as in time the cement breaks loose from the brick.

26. Door Sills.—Door sills should be laid by methods similar to those described under window sills. When brick are used, they should be hard-burned to withstand the wear and should have a slope of approximately $\frac{3}{8}$ in. to the foot.

27. Setting Door and Window Frames.—Wood window and door frames for brick walls have a staff bead, or "brick mold," to cover the joint between frame and brick. Standard wood double-hung window frames for brick walls have the window weights boxed in. A strip of wood or metal is often nailed to the side and the head of a door or casement frame to form a wind stop, so that the shrinking of the frame will not allow the wind to blow straight through from the outside. Some form of wind stop should always be used. Frame sizes and dimensions are standardized to some extent but special sizes are just as frequently used. It is easy to use frames of any desired height with brickwork, the small units and the possibility of varying the width of the joints making brickwork dimensions adjustable to fit any case. The carpenter is usually responsible for the setting, leveling, and plumbing of frames; but the bricklayer should check them himself and be sure they are plumb and correctly placed. Frames should be lined up with the face of the wall and set back far enough to allow a 4-in. or an 8- or 12-in. bonded jamb, with proper clearance, otherwise the bricklayer will be obliged to cut every course against the frame, thus wasting time and labor.

28. In the basement and upon the first floor the frames are sometimes braced by boards nailed to stakes in the ground outside of the building. Usually a group of frames is braced by horizontal braces attached to an upright cleated to the floor, the braces being placed above the level of the scaffold so as not to interfere with its placing. For this reason, frames should not be braced diagonally to the floor. Brick piled upon the

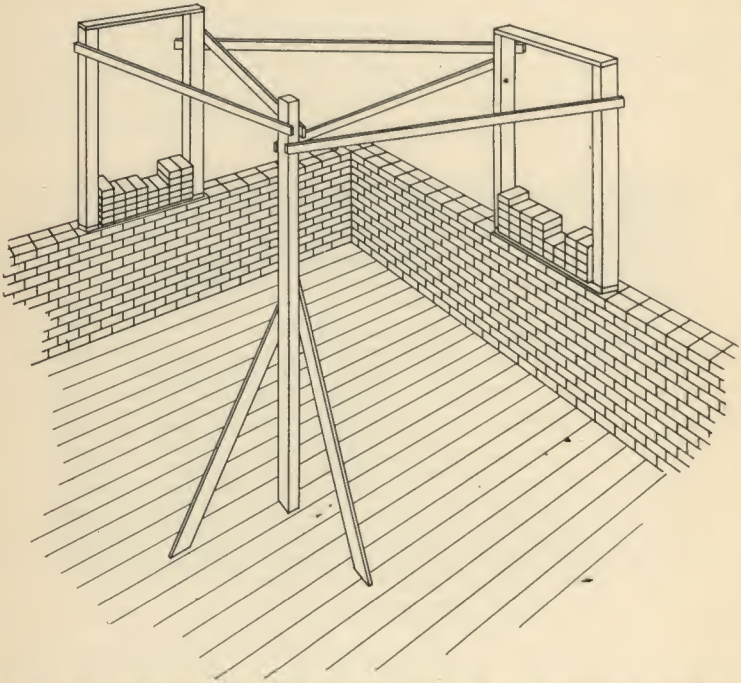


FIG. 134.—Method of bracing window frames to allow room for scaffold beneath braces.

bottom of the frame help to steady it. For outside walls the frames should always be set in a bed of mortar before the wall has risen beyond the level of the sill and the joint slushed full. It is often necessary to make the frame more rigid by temporarily bracing it diagonally. To prevent them from being marred and soiled by the workers, wood frames occurring in interior walls are seldom set until the wall is up. Steel frames

have a flange which is usually backed up against the edge of the jamb and held in place by the backing being laid against it. Steel frames should always be built into place to make a neat job.

29. Caulking Frames.—In first-class work the brick mold comes loosely tacked to the window or door frame and is afterwards removed and the joint completely filled with oakum

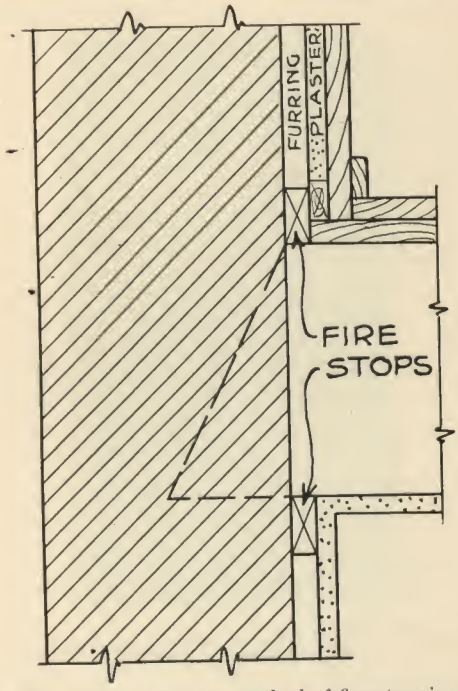


FIG. 135.—Alternate method of fire-stopping.

with a hammer and dull chisel. This operation is known as caulking. The brick mold is nailed back in place by the carpenter. Caulking is sometimes done by the bricklayer, although more frequently by the carpenter. Frames are sometimes pointed with mortar in lower cost work.

30. Fire Stops.—Devices for preventing the spreading of fire from floor to floor are called fire stops. Where the wall is of uniform thickness, above and below the joists, the wall may

be "corbeled out" for a number of courses equal to the depth of the joist and the width of the furring. This seals the furring space between the wall and the plaster and prevents a draft from carrying the fire from floor to floor. This has the disadvantage, however, of bringing the masonry into contact with the plaster at this point which partly defeats the moisture-proofing objective in using furring. It is believed that equally

FIG. 136.—Four inch bearing partition.

satisfactory results may be obtained by using horizontal strips of furring above and below the joists (see booklet on "Fire-stopping," issued by the National Lumber Manufacturers' Association, Transportation Bldg., Washington, D. C.) (Fig. 135). Where walls are not furred, this is unnecessary. For walls decreasing in size from a thicker to a thinner wall, the beams should be filled to the floor level with brick laid in mortar to the thickness of the wall beneath. A 4-in. tier of brick may be carried up between the rafters over the roof

plates to the sheathing on the roof. This makes a warmer house and acts as a wind stop.

31. Four-inch Brick Walls.—Four-inch brick partitions will bear greater loads than partitions of studs and have fire-resisting qualities as well. When started above the floor of the basement, these may be supported upon steel joists. Four-inch brick walls are worthy of wider use (see "Brick—How to Build and Estimate").

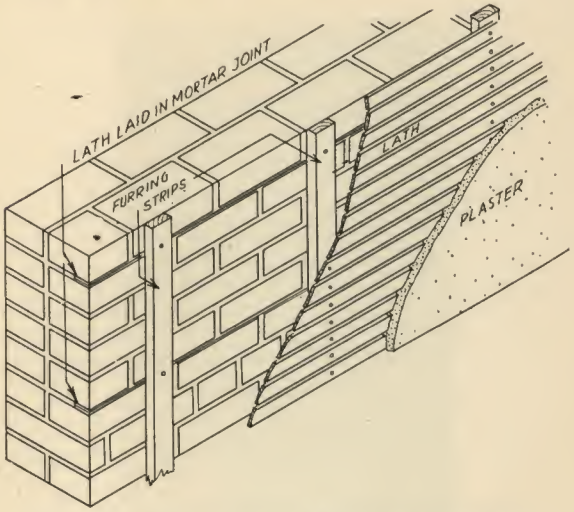


FIG. 137.—Ordinary method of furring a brick wall.

32. Nogging.—The filling in of the spaces between studding or between half-timber with brick is called "nogging" and was a common practice in colonial construction. This device is sometimes used as a fire stop between studs. Its efficiency is questionable, because the wood studs form the weak points.

33. Furring and Its Support.—Plaster in some dry climates may be applied directly to the inside of the solid wall. In the average climate it is best to plaster over furring. This leaves a moisture-resisting space between the plaster and the wall. If the furring is of wood and is nailed horizontally, it acts as a fire stop as well. This is not very practical, however.

Wood or metal furring is generally nailed into laths laid in horizontal joints about every seventh course or into plugs or nailing blocks built into the wall. Such blocks are also used as a nailing base for trim, etc. The furring is sometimes nailed to mortar joints or dry joints left for this purpose. Such joints are not dependable, however. Split furring tile 3 or 4 in. thick, which are scored so that they can be split in half, are sometimes used (see Fig. 14). The tile is set without

Fig. 138.—Nailing blocks.

mortar on the back of the ribs to avoid solid contact with the wall and anchored at every second course by driving ten-penny nails into the mortar joints of the wall over every third tile and bending the head of the nail down over the tile. Tile provides a good surface upon which to plaster. Porous brick may be laid in place of nailing blocks as the furring may be nailed directly to them. Special metal lath is made which, due to its ribbed construction in itself, constitutes furring.

34. Vaulted Walls.—A cavity or vaulted wall is excellent construction for small buildings. Two 4-in. tiers separated by an air space of 2 in. and held together by metal wall ties are sometimes used. Although the ties may rust, this is still a reliable form of construction where superimposed loads are not great. Flemish bond headers are sometimes used for bonding of metal ties, the header coming flush with the face

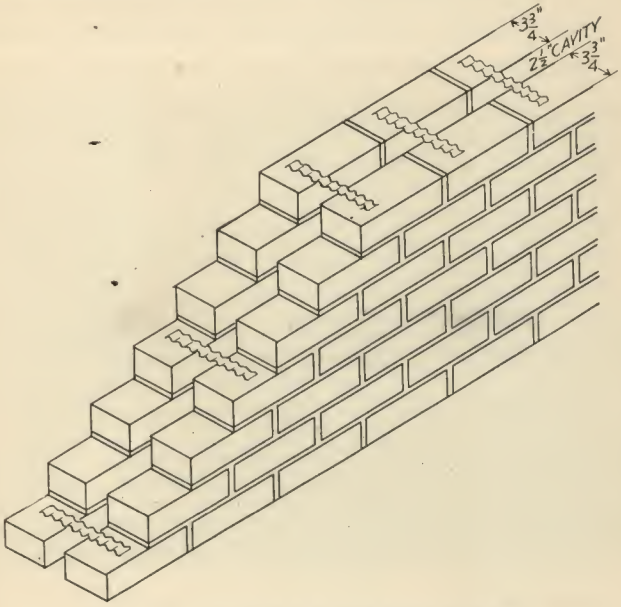


FIG. 139.—Vaulted wall with metal wall ties.

of the wall and recessed on the inner face of the wall, the recess being filled with mortar. Furring is generally unnecessary with vaulted construction.

35. Veneered Walls.—In many cases, it is possible to materially improve an old frame property by veneering it with a shell of 4 in. of brickwork. The brickwork undoubtedly adds to the life of the house and "paints" it with an enduring surface which does not have to be renewed. Old frame houses were generally built more sturdily, with larger timbers than

in frame houses of today, and they with their foundations can often be relied upon to support the veneering.

36. It is a great mistake, however, to construct new buildings of brick veneer on frame. One of the great advantages of brick construction is the permanence and fire resistiveness of its walls—qualities lacking in brick veneer. Upon a frail support of shrinking 1⅝- by 3⅝-in. studs is placed the heavy duty not only of supporting the dead and live loads of the house, but also of adding to it a weight of several tons of brickwork

FIG. 140.—A sham front on a wood building, deadly dangerous to firemen if the building burns, and deceptive to possible purchasers and occupants.

built so that its stability is negligible. Especially when a wind is blowing the resulting racking and straining is a tax on the strength of the framework. A heavy wind may rip the brick veneering off entirely. In a wall of sound construction the entire wall should act as a unit in bearing loads and resisting stresses.

37. A fire starting in a veneered house burns not only the inside of the house, but the wood part of the outside walls; and the collapse of the brick shell upon the ruins is almost certain. With the brick veneer house the lower insurance rate of the real brick house is forfeited.

38. Brick veneer costs more than a solid or Ideal brick wall in any part of the country. Especially since the advent of the Ideal wall, there are no good reasons for using this thoroughly unsound type of construction, which is both a deception and a snare.

39. Filling Putlog Holes.—Putlog holes should be cleaned out before the mortar has set hard. The brick should then be wet and more mortar than is required to fill the joints should be plastered on to all of the exposed surfaces. The brick to be inserted should be cut to a wedge shape on the top and the bottom so that it may be wedged into the mortar. It should be hammered home so that the mortar will be forced out all about the joints. The jointing should be matched to that of the wall about it, whether good or bad.

40. Laying Second-hand Brick.—In laying second-hand brick the best brick should be selected for the face of the wall. Smoke or chemicals upon the face of the brick wall, unless removed, stain any application of whitewash, paint, or plaster. Second-hand brick are mostly used for backing and other unexposed work.

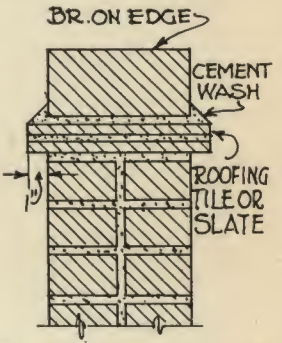


FIG. 141.—Capping for garden walls.

41. Garden Walls.—Garden walls should be approximately 8 in. thick and, for the average wall, should be reinforced every 10 ft. by pilasters about 12 in. thick. The lower the wall, the longer the distance that may be left between pilasters; and the higher the wall, the larger the pilasters and the nearer they should be spaced. A curve or a bend in the wall will reinforce it as effectually as a pilaster. The wall needs no footing where the supporting earth is sufficiently firm, but it should be extended below the frost line. It may have a coping of tile, cement, stone, or headers set in rich cement. It is good practice to lay an absolutely watertight coping upon a garden wall, with a drip on each side, to lessen the possibility of efflorescence.

42. In the case of a wall dividing the same property into two or more parts, a wall 4 in. in thickness may be built, as shown in Fig. 142, the curves in the plan of the wall giving it the necessary stability. The wall shown, 4 in. thick and about 8 ft. high, has been standing over a century. It produces a variety of shady and sunny surfaces.

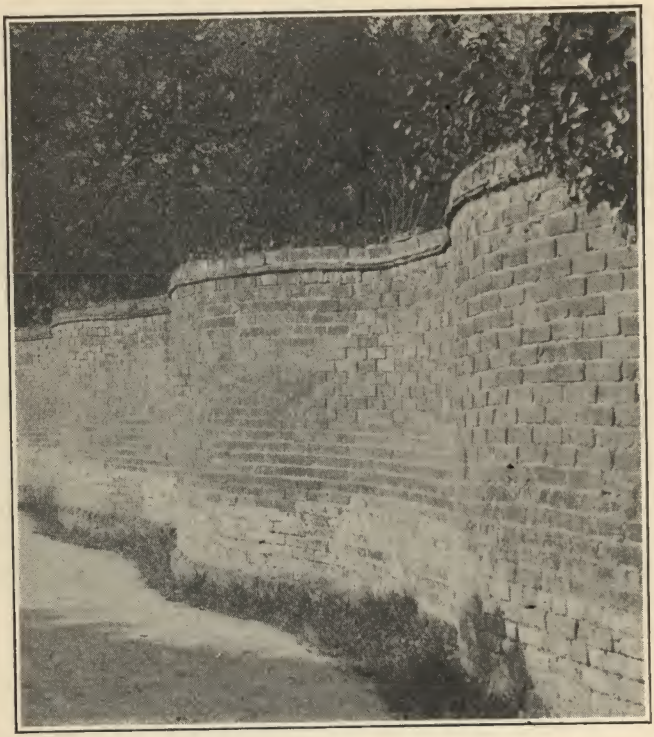


FIG. 142.—Beautiful curved garden wall 4 in. thick.

43. Very artistic and durable steps may be laid with brick, the treads being at least 12 in. wide with a slope of approximately ¼ in. per foot. Full-length headers laid either flat or on end should always be used for the front of the tread. The joints, which should be filled with a rich cement mortar should be finished with a "thumb" joint, which is a joint thoroughly rubbed with a steel jointing tool. The ends of the

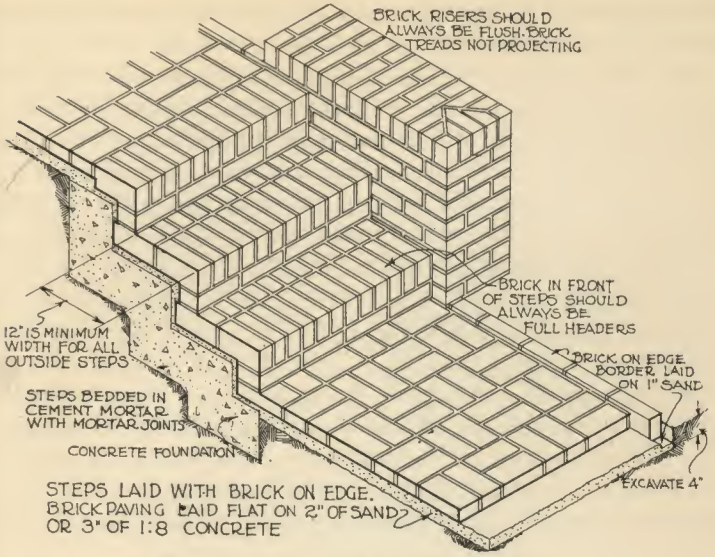


FIG. 143.—Steps laid with brick on edge.

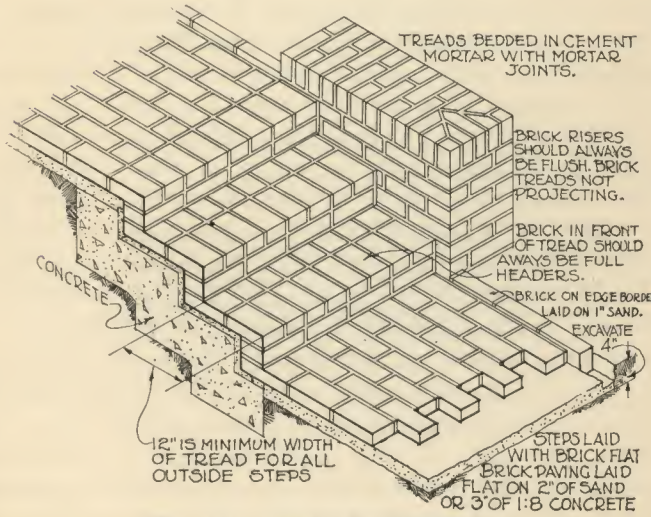


FIG. 144.—Steps laid with brick flat.

threads should be kept flush with risers and all treads should be laid on a concrete base.

44. Gate Posts.—Twelve-by-twelve inch gate posts may be built in the form of solid or hollow piers. They should be started below the frost line and laid in rich cement mortar. If the posts are built hollow, gates, fences, ornamental lamps, etc. should be anchored entirely through the posts by long bolts. For posts carrying heavy gates, solid construction should be used and the bolts anchored in the posts by washers, or by splitting the ends of the straps and turning one up and one down, or placing a vertical piece of steel within the pier and bolting through it.

45. Pavements.—Brick are frequently used for pavements and walks. Hard-burned common brick or paving brick are used for this purpose. For basement paving and garden walks the brick are frequently laid upon a well-drained bed of sand or cinders rolled until it is level and hard. The brick are laid either flat or on edge and grouted by pouring a 1:3 cement mixture into the joints, the surface being wiped clean before the cement has set. The grout is sometimes forced into the joints by the use of an old broom. For an inexpensive job, such as a garden walk, the joints are often filled with a mixture of sand and salt, there being just enough salt in the mixture to prevent the growth of weeds between the brick. If a permanent job is desired on ground that is damp and soft, a 1:8 concrete foundation should be laid with the brick on top. When paving streets, the brick are always laid on edge, either over a hard-rolled sand or over a cinder surface or a concrete foundation, the joints being grouted with cement or preferably filled with asphalt. An expansion joint about every 15 ft., which may be filled with sand or asphalt, is desirable.

46. Panels.—The use of specially designed brick, terra cotta, and wall tile, of common or face brick laid in decorative patterns, of combinations of cement surfaces and brick patterns, of stone, of half timbering, and of cast-cement ornamentation is common in decorative paneling. A drawing of the panel is of course provided according to which the bricklayer must work. It is sometimes the practice to lay

previously a decorative brick or tile design horizontally upon a form, filling the joints with mortar, and after the latter has set, place the panel as a unit.

47. Miscellaneous Decoration.—To achieve artistic effects on the face of the wall, sections of stone, tile, and varicolored

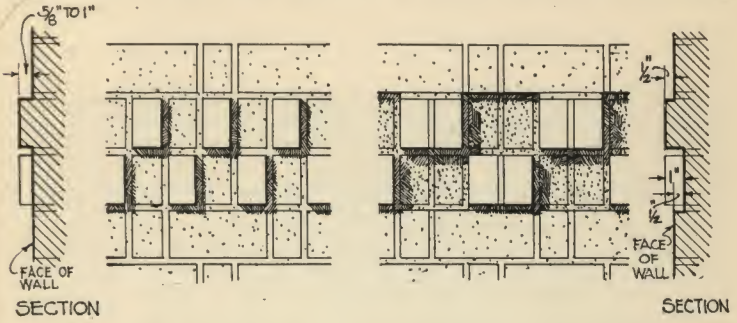


FIG. 145.—Elevations showing two arrangements for ornamental string or sailing course.

brick arranged in patterns are commonly used. A marked pole is frequently of great assistance in laying brick to a specified design as it serves as a check and guide.

48. Belt, String, and Sailing Courses.—A course of brick, stone, tile, or terra cotta projecting from a wall is called a

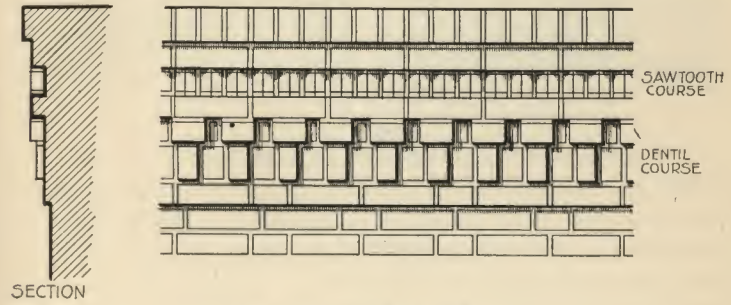


FIG. 146.—A brick cornice.

string or sailing course. It is sometimes used for decorative purposes, to break the uniformity of a large expanse of wall. A similar course flush with the wall is called a belt course.

49. Dentil Course.—Brick laid parallel to the face at the wall alternating in and out is sometimes used to form a dentil course.

50. Saw-tooth Course.—A course laid at 45 deg. with the face of the wall is a saw-tooth course.

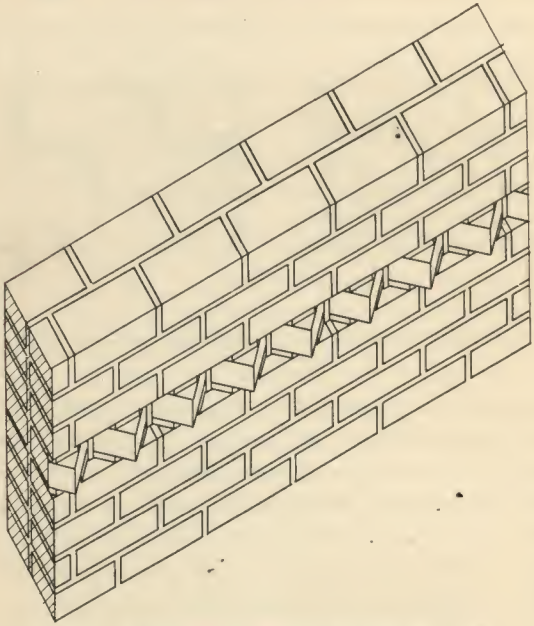


FIG. 147.—Sawtooth course.

51. Corbel.—Where courses of brick in the wall are projected beyond the normal face of a wall or pier to form a self supporting projection, this is called a "corbel" and the operation of forming a corbel is referred to in the trade as "corbeling." The deeper the brick are imbedded in the wall, the greater the load they will carry. Projections should be formed of headers. A section of corbeling should never be greater than twice the thickness of the wall itself, and no projecting course should extend more than 2 in. beyond the brick below it. If the projection is 4 in. or more, a series of steps will be formed. Cor-

beling is used to support roof gutters, chimneys, for fire stops, cornices, ornamentation, and for many other purposes.

52. Corbeling should be laid in line by the bottom edge of the brick. Corbeling should be well tied down or bonded and backed up every course to prevent accidents.

53. Interior Finish.—Brick may be made to serve most satisfactorily as an interior finish in many buildings. In public

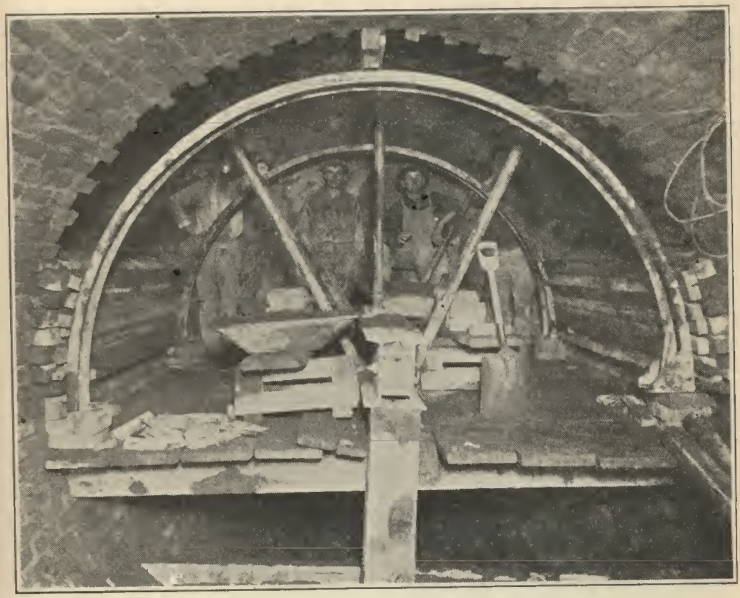


FIG. 148.—Brick sewer being constructed by tunnelling method. Note type of centering.

buildings, offices, and apartment hallways, pleasing and artistic effects may often be obtained by careful selection of brick, bond, and joints and by the employment of panels of brick in attractive designs. For factory construction, brick forms an excellent surface for the application of whitewash and paint.

54. Stucco.—Brick, is an excellent base for stucco, due to the fact that it will bond readily with it and does not shrink. When a brick wall is to be covered with stucco, hard-burned

cull brick is sometimes used for economy. It should always be remembered that, contrary to general belief, stucco is of little value in keeping out moisture. Joints should be left rough, and the bricks wet before the stucco is applied.

55. Septic Tanks, Sewers and Manholes.—Brick is well adapted for the construction of septic tanks, sewers, and manholes. The ability of brick to resist the corrosive action of

FIG. 149.—Egg shaped sewer under construction.

sewage and of sewer gases makes it particularly suitable for these purposes. The brick should be laid in rich cement mortar.

56. Protecting Limestone.—The surface of limestone which is to come in contact with brickwork laid in mortar containing Portland cement should be coated with an impervious liquid backing compound to prevent the Portland cement from staining it. Several such backing compounds are on the

market. The stone itself is laid either in lime mortar or in stainless cement mortar.

57. Cleaning the Wall.—All exposed brick should be scrubbed soon after completion with water and not more than 5 per cent by volume muriatic acid, or about 1 pt. to 4 gal. of water. A stronger solution may injure the wall. Afterwards, scrub thoroughly with clean water to remove the acid.

UNIT X–B

THE IDEAL WALL

1. Definition.—This is the name given to a new type of brickwork. Using standard brick, this new development produces a substantial and well-insulated wall of any thickness from 8 in. up. There is no patent or royalty on this construction.

FIG. 150.—An Ideal all-rolok school.

2. Advantages.—The Ideal wall has the great advantage of a considerable saving in both materials and labor, combining the advantages of the solid-brick and hollow-unit types of wall at a lower cost than either.

3. Two Types of Ideal Wall.—In the *Ideal all-rolok wall* all the brick are laid on edge.

4. In the Ideal rolok-bak wall the brick in the outer 4-in. course are laid on their flat bed, so that the wall has the usual

brick appearance; the backing brick being on edge. Header courses may be run at every third or every sixth courses and any bond may be used.

5. With the Ideal rolok-bak wall, each header which extends from the flat outer course to the backing of brick on edge must have a small filling piece placed over it to make the brick on edge course line on top.

FIG. 151.—Building an Ideal all-rolok house.

6. It is not necessary for the bricklayer to cut a special piece for this filler. Brick chips lying on the scaffold can be used for this purpose, well slushed with mortar.

7. Interruption of Mortar Joint.—Examination of the plates will show that the Ideal wall has a positive break in the mortar joint in the direction of the thickness of the wall.

8. In a wall above grade it is almost impossible under conditions existing in actual practice, for a well-burned header to carry moisture along its entire length by capillary attraction. Moisture can, under severe conditions, be conducted along a mortar joint either of cement or of lime mortar; hence the importance of interrupting the joint.

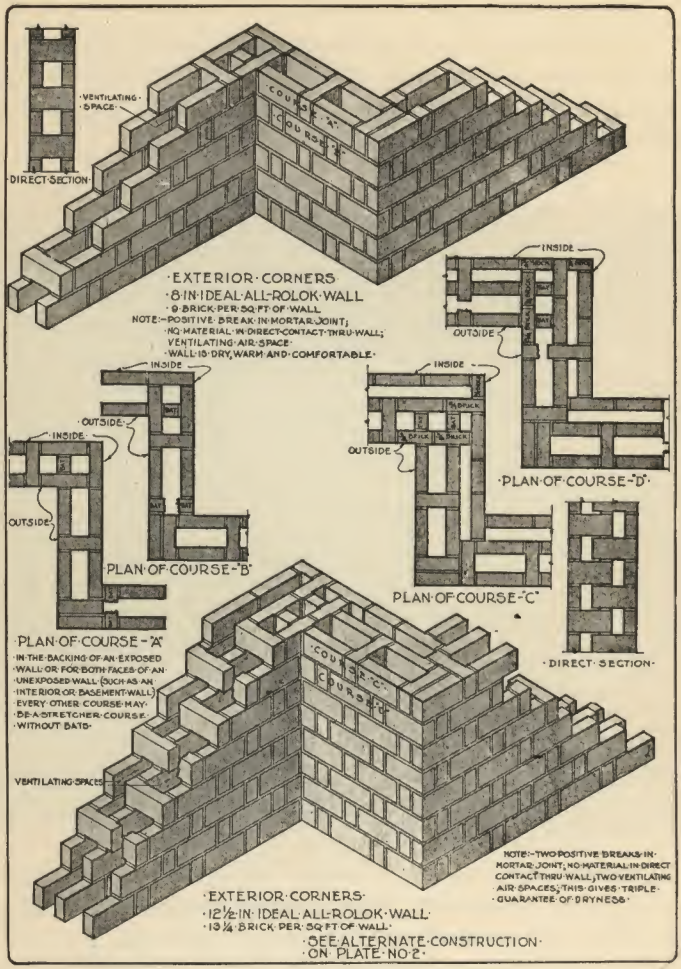

VENTILATING SPACE
DIRECT SECTION
COURSE "A"
COURSE "B"
EXTERIOR CORNERS
8 IN IDEAL ALL-ROLOK WALL
9 BRICK PER SQ FT OF WALL
NOTE:—POSITIVE BREAK IN MORTAR JOINT; NO MATERIAL IN DIRECT CONTACT THRU WALL; VENTILATING AIR SPACE WALL IS DRY, WARM AND COMFORTABLE
INSIDE
OUTSIDE
PLAN OF COURSE "D"
PLAN OF COURSE "B"
PLAN OF COURSE "C"
PLAN OF COURSE "A"
IN THE BACKING OF AN EXPOSED WALL OR FOR BOTH FACES OF AN UNEXPOSED WALL (SUCH AS AN INTERIOR OR BASEMENT WALL) EVERY OTHER COURSE MAY BE A STRETCHER COURSE WITHOUT BATS
DIRECT SECTION
COURSE "C"
COURSE "D"
VENTILATING SPACES
NOTE:—TWO POSITIVE BREAKS IN MORTAR JOINT; NO MATERIAL IN DIRECT CONTACT THRU WALL; TWO VENTILATING AIR SPACES; THIS GIVES TRIPLE GUARANTEE OF DRYNESS
EXTERIOR CORNERS
12½ IN IDEAL ALL-ROLOK WALL
13¼ BRICK PER SQ FT OF WALL
SEE ALTERNATE CONSTRUCTION ON PLATE NO 2

PLATE VIII.

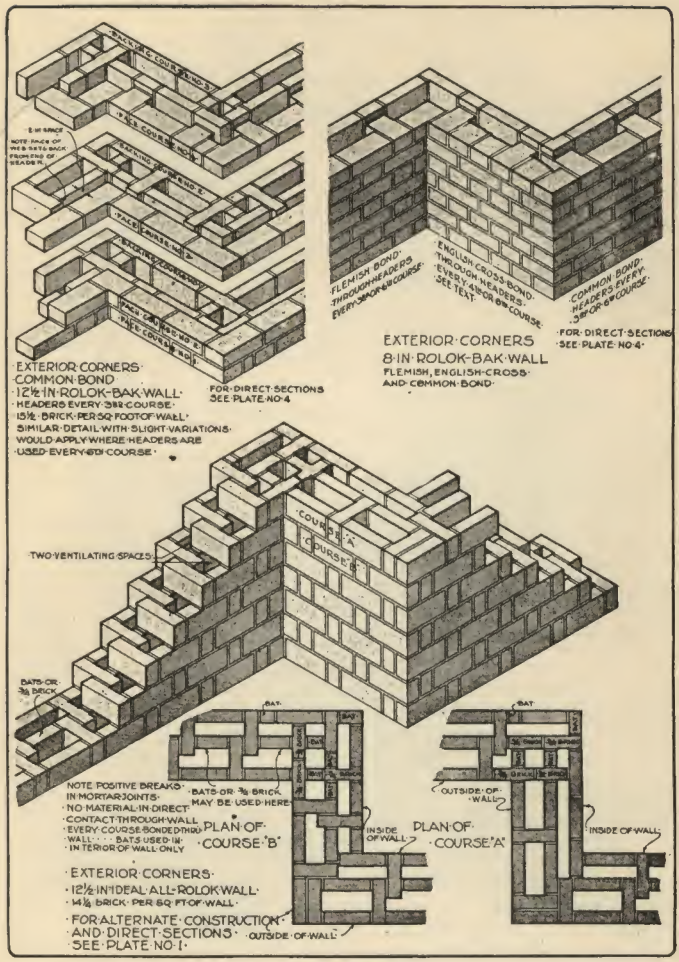

EXTERIOR CORNERS
COMMON BOND
12½ IN ROLOK BAK WALL
HEADERS EVERY 3RD COURSE
15½ BRICK PER SQ FOOT OF WALL
SIMILAR DETAIL WITH SLIGHT VARIATIONS
WOULD APPLY WHERE HEADERS ARE
USED EVERY 6TH COURSE
FOR DIRECT SECTIONS
SEE PLATE NO 4
FLEMISH BOND
THROUGH HEADERS
EVERY 3RD COURSE
ENGLISH CROSS BOND
THROUGH HEADERS
EVERY 4 & 6TH OR 6 & 8TH COURSE
SEE TEXT
COMMON BOND
HEADERS EVERY
3RD OR 6TH COURSE
EXTERIOR CORNERS
8 IN ROLOK BAK WALL
FLEMISH, ENGLISH CROSS
AND COMMON BOND
FOR DIRECT SECTIONS
SEE PLATE NO 4
TWO VENTILATING SPACES
COURSE A
COURSE B
BATS OR ¾ BRICK
NOTE POSITIVE BREAKS
IN MORTAR JOINTS
NO MATERIAL IN DIRECT
CONTACT THROUGH WALL
EVERY COURSE BONDED THRU
WALL BATS USED IN
INTERIOR OF WALL ONLY
BATS OR ¾ BRICK
MAY BE USED HERE
PLAN OF
COURSE "B"
INSIDE OF WALL
OUTSIDE OF WALL
PLAN OF
COURSE "A"
INSIDE OF WALL
EXTERIOR CORNERS
12½ IN IDEAL ALL ROLOK WALL
14⅛ BRICK PER SQ FT OF WALL
FOR ALTERNATE CONSTRUCTION
AND DIRECT SECTIONS
SEE PLATE NO 1
OUTSIDE OF WALL

PLATE IX.

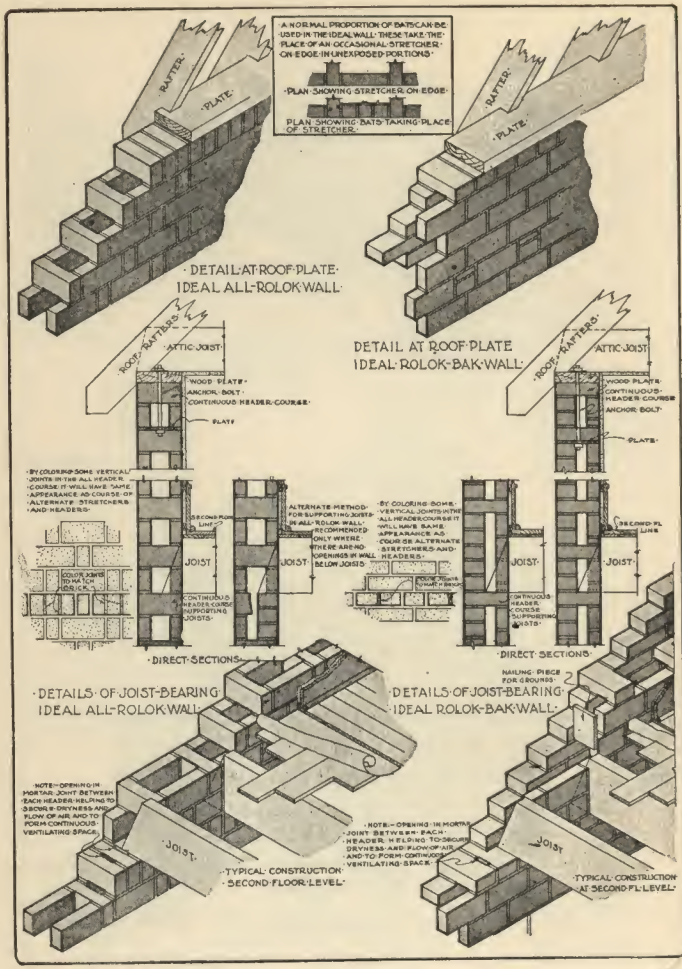

A NORMAL PROPORTION OF BATS CAN BE USED IN THE IDEAL WALL. THESE TAKE THE PLACE OF AN OCCASIONAL STRETCHER ON EDGE IN UNEXPOSED PORTIONS.
PLAN SHOWING STRETCHER ON EDGE
PLAN SHOWING BATS TAKING PLACE OF STRETCHER
RAFTER
PLATE
DETAIL AT ROOF PLATE IDEAL ALL-ROLOK WALL
DETAIL AT ROOF PLATE IDEAL ROLOK-BAK WALL
ROOF RAFTERS
ATTIC JOIST
WOOD PLATE
ANCHOR BOLT
CONTINUOUS HEADER COURSE
PLATE
BY COLORING SOME VERTICAL JOINTS IN THE ALL HEADER COURSE IT WILL HAVE SAME APPEARANCE AS COURSE OF ALTERNATE STRETCHERS AND HEADERS
ALTERNATE METHOD FOR SUPPORTING JOISTS IN ALL-ROLOK WALL RECOMMENDED ONLY WHERE THERE ARE NO OPENINGS IN WALL BELOW JOISTS
SECOND FLOOR LINE
JOIST
COLOR JOINTS TO MATCH BRICK
CONTINUOUS HEADER COURSE SUPPORTING JOISTS
DIRECT SECTIONS
DETAILS OF JOIST-BEARING IDEAL ALL-ROLOK WALL
DETAILS OF JOIST-BEARING IDEAL ROLOK-BAK WALL
NAILING PIECE FOR GROUNDS
NOTE—OPENING IN MORTAR JOINT BETWEEN EACH HEADER HELPING TO SECURE DRYNESS AND FLOW OF AIR AND TO FORM CONTINUOUS VENTILATING SPACE
TYPICAL CONSTRUCTION SECOND FLOOR LEVEL
TYPICAL CONSTRUCTION AT SECOND FL LEVEL

PLATE X.

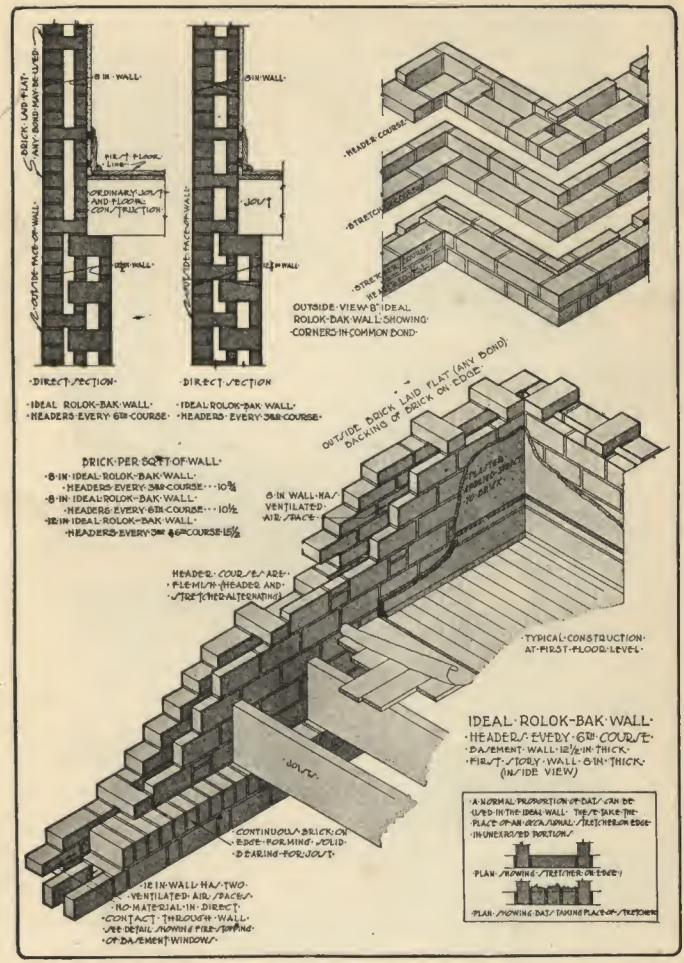

8 IN. WALL
FIRST FLOOR LINE
ORDINARY JOIST AND FLOORING CONSTRUCTION
OUTSIDE FACE OF WALL
BRICK LAID FLAT (ANY BOND) MAY BE USED
DIRECT SECTION
IDEAL ROLOK-BAK WALL
HEADERS EVERY 6TH COURSE
8 IN. WALL
JOIST
12 IN. WALL
OUTSIDE FACE OF WALL
DIRECT SECTION
IDEAL ROLOK-BAK WALL
HEADERS EVERY 3RD COURSE
HEADER COURSE
STRETCHER COURSE
OUTSIDE VIEW OF IDEAL ROLOK-BAK WALL SHOWING CORNERS IN COMMON BOND
OUTSIDE BRICK LAID FLAT (ANY BOND) BACKING OF BRICK ON EDGE
BRICK PER SQ. FT. OF WALL
8 IN. IDEAL ROLOK-BAK WALL
HEADERS EVERY 3RD COURSE . . . 10⅜
8 IN. IDEAL ROLOK-BAK WALL
HEADERS EVERY 6TH COURSE . . . 10½
12 IN. IDEAL ROLOK-BAK WALL
HEADERS EVERY 3RD & 6TH COURSE 15½
8 IN. WALL HAS VENTILATED AIR SPACE
FURRED AND PLASTERED ON BRICK
HEADER COURSES ARE PLEMUM (HEADER AND STRETCHER ALTERNATING)
TYPICAL CONSTRUCTION AT FIRST FLOOR LEVEL
IDEAL ROLOK-BAK WALL
HEADERS EVERY 6TH COURSE
BASEMENT WALL 12½ IN. THICK
FIRST STORY WALL 8 IN. THICK
(INSIDE VIEW)
JOIST
CONTINUOUS BRICK ON EDGE FORMING SOLID BEARING FOR JOIST
12 IN. WALL HAS TWO VENTILATED AIR SPACES
NO MATERIAL IN DIRECT CONTACT THROUGH WALL
SEE DETAIL SHOWING FIRE STOPPING OF BASEMENT WINDOWS
A NORMAL PROPORTION OF BATS CAN BE USED IN THE IDEAL WALL THEY TAKE THE PLACE OF AN EQUAL NUMBER OF STRETCHERS ON EDGE IN UNEXPOSED PORTION
PLAN SHOWING STRETCHER ON EDGE
PLAN SHOWING BAT TAKING PLACE OF STRETCHER

PLATE XI.

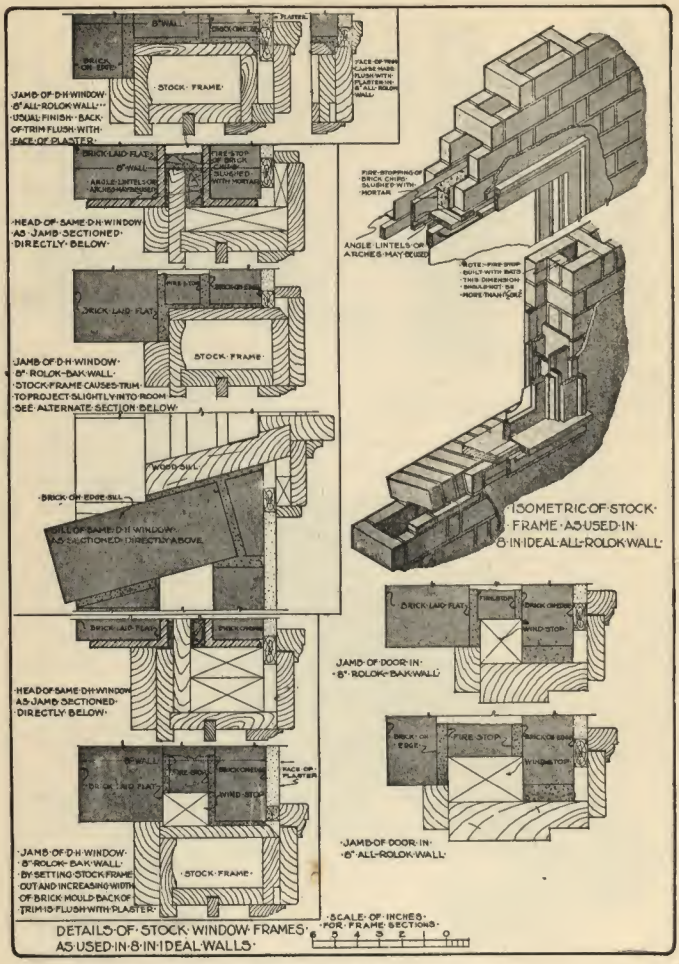

JAMB OF D.H. WINDOW 8" ALL-ROLOK WALL... USUAL FINISH - BACK OF TRIM FLUSH WITH FACE OF PLASTER
HEAD OF SAME D.H. WINDOW AS JAMB SECTIONED DIRECTLY BELOW
JAMB OF D.H. WINDOW 8" ROLOK-BAK WALL STOCK FRAME CAUSES TRIM TO PROJECT SLIGHTLY INTO ROOM SEE ALTERNATE SECTION BELOW
SILL OF SAME D.H. WINDOW AS SECTIONED DIRECTLY ABOVE
HEAD OF SAME D.H. WINDOW AS JAMB SECTIONED DIRECTLY BELOW
JAMB OF D.H. WINDOW 8" ROLOK-BAK WALL BY SETTING STOCK FRAME OUT AND INCREASING WIDTH OF BRICK MOULD BACK OF TRIM IS FLUSH WITH PLASTER
DETAILS OF STOCK WINDOW FRAMES AS USED IN 8 IN IDEAL WALLS
ISOMETRIC OF STOCK FRAME AS USED IN 8 IN IDEAL ALL-ROLOK WALL
JAMB OF DOOR IN 8" ROLOK-BAK WALL
JAMB OF DOOR IN 8" ALL-ROLOK WALL
SCALE OF INCHES FOR FRAME SECTIONS
6 5 4 3 2 1 0

PLATE XII.

9. The 8-in. Ideal wall has one break in the mortar joint and the 12-in. wall has two.

10. Ventilated Air Space.—To further safeguard the inside surface, a slight steady circulation of air in the cavity dries out any small amount of moisture that might reach the portion of the header within the hollow space.

11. The 8-in. wall has one ventilated space, the 12-in. wall has two. There is, moreover, no material in direct contact through the 12-in. wall from front to back.

12. Brick for the Ideal Wall.—No special sizes or shapes of brick are required for the Ideal wall. Standard size brick, 2¼ by 3¾ by 8 in. either face or common, are used.

13. Greater speed of construction is possible when a non-impervious brick is used for Ideal wall construction. The use of shale or similar hard impervious brick slows down the work where the brick are laid on edge. The use of non-impervious brick is also advisable for the reason that such brick make the most weather-resistive wall in Ideal construction. It will readily be seen that during a very heavy and long continued downpour of driving rain an absolutely impervious header might conduct a slight amount of moisture along its surface toward the inner face of the wall, whereas a header of non-impervious brick would absorb this moisture, which would be dried out by the slight steady circulation of air within the hollow space.

14. Omission of Furring.—From many parts of the United States users report that plaster applied directly to the inside brick surface of properly built Ideal walls—without the use of furring—has proved satisfactory, and that with walls so constructed buildings are warm, dry, and comfortable. To obtain this result there must be also reasonably good mortar and workmanship, and where such are used it is the belief of the author, based on a record of satisfactory performance, that furring may be safely omitted with the 8-in. Ideal wall and the plaster applied directly to the inside brick surface; excepting in those parts of the United States which have long continued periods of severely cold weather, such as northern Michigan, the Dakotas, and Montana, in which localities the

8-in. wall should be furred or the 12-in. unfurred Ideal wall used instead. The brick in all cases should be selected as recommended in paragraph 13.

15. Ideal Construction, for What Use Adapted.—Ideal construction is adapted for the following uses:

a. Foundations and walls of the superstructure of all residences.

FIG. 152.—Ideal all-rolok wall.

b. Load-bearing walls wherever the hollow unit type of wall is now employed or allowed.

c. Spandrel, curtain, and partition walls.

16. For fire, division, and party walls only solid brickwork should be considered, according to the best engineering practice.

17. Dr. A. H. Stang, of the U. S. Bureau of Standards, recently stated that "Compressive tests under central loading of 8-in. walls, both Ideal and solid, showed that they had equal strength whether lime, lime cement, or cement mortar was used. Under central loading, 8-in. walls laid with

cement mortar were 24 per cent stronger than if laid with lime cement mortar, and 84 per cent stronger than if lime mortar had been used."

18. The strength of the Ideal rolok-bak wall, while less than that of the all-rolok wall, closely approaches the strength of the solid wall also.

FIG. 153.—Bay windows or other ornamental features present no special difficulty in Ideal construction.

19. Appearance of Ideal All-rolok Wall.—The Ideal all-rolok wall is laid in Flemish bond. With any brick it has a distinctive appearance, even when the rough or wire-cut surface of the stretchers is exposed in combination with the smooth end of the headers.

20. Thickness of Ideal Walls.—For residence construction, Ideal walls need be no thicker than required for walls of solid masonry.

21. Flexibility in Thickness of 12½-in. Wall.—The exact thickness of the 12½-in. wall may be varied considerably to suit any special condition. It may be made from 11¼ to 13¾ in. thick.

22. Use of Bats.—The usual proportion of bats may be used in the Ideal wall. An occasional stretcher on edge in the backing may be replaced by three small bats, by a three-quarter brick and a small bat, or by two bats half a brick long. In the 12½-in. all-rolok wall, shown on Plate No. IX, the bats or the three-quarter brick may be placed entirely on the inside web, and the inside and outside face built entirely of whole bricks.

23. Bond of Ideal All-rolok Wall.—In the 8-in. Ideal all-rolok wall (Plate VIII) and the 12½-in. Ideal all-rolok wall (Plate VIII) the wall is bonded entirely through at every course by headers spaced 10¾ in. on center. In the 12½-in. Ideal all-rolok wall, shown on Plate IX, the center web is bonded to either the inner or outer web at every course. Although the 12½-in. Ideal all-rolok wall, shown on Plate IX, requires one brick more per square foot of area than that on Plate VIII, it is a cheaper wall to construct, there being no bats to place that will show on the outside face. The wall, shown on Plate IX, is not so well bonded on the center web as the other type, but it is amply strong for all ordinary purposes.

24. Bond of All-stretcher Courses 12½-in. Ideal All-rolok Wall.—For basement walls below grade, alternate courses on both sides of the 12½-in. wall, shown on Plate VIII, may consist entirely of stretchers. For similar 12½-in. walls above grade, with one side only exposed, alternate courses on the back of the wall only may consist entirely of stretchers, the bond being preserved on the face by the use of bats (Fig. 154).

25. It is important that the all-stretcher courses on the unexposed face break joint, as shown in Fig. 154. At every third stretcher it is seen that the difference in the unit of length will cause the vertical joints to coincide. By breaking the

joints of the stretchers, no more than three vertical joints will coincide, as shown. Such coinciding of vertical joints does not weaken the wall but rather strengthens it.

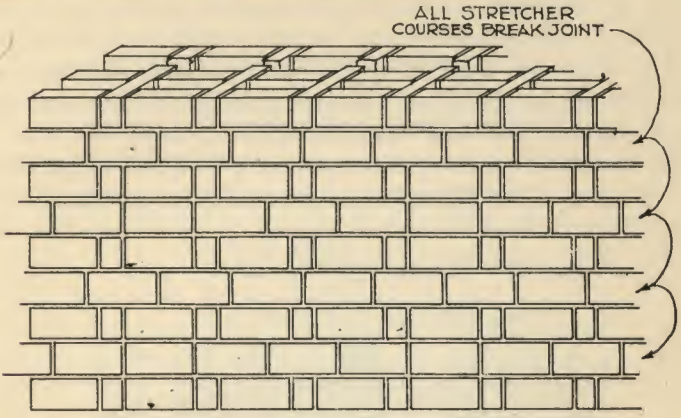


FIG. 154.—Unexposed side 12½ in. ideal all-rolok wall.

26. Exposed Bond, Ideal Rolok-bak Walls.—Any bond may be used with the Ideal rolok-bak wall. With common

FIG. 155.—A 12-in. rolok-bak wall.

bond, Flemish header courses are recommended, these consisting of headers and stretchers placed alternately.

27. With Flemish bond the exposed headers in each third or sixth course only should be through headers, the remainder being bats.

28. With English bond or English cross-bond it is evident that through headers must occur at every fourth or sixth course, instead of every third or sixth course as with other bonds. Where headers every fourth course are preferred, the arrangement, shown in Fig. 156 should be used.

29. Header Courses as Joist Support, Ideal All-rolok Wall. In the Ideal all-rolok wall the joists may be supported on a full-header course, this method having the advantage that the headers form a fire stop at the story line.

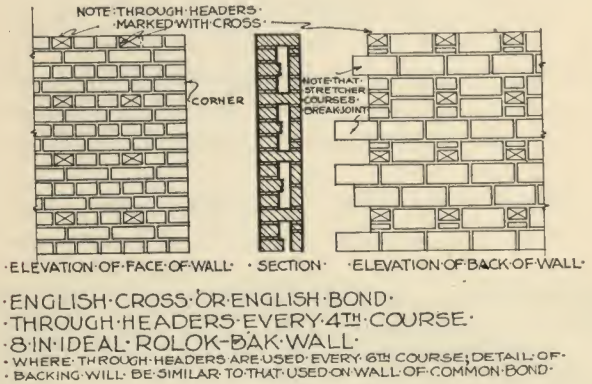


FIG. 156.

30. Where the joists are supported on an offset in the wall (see typical construction at first floor level, Plate XI), the joints in the header course should be slushed full.

31. Where the wall is 8 in. thick above and below, the joists (see typical construction at second floor level, Plate X), the vertical joints between headers should be open in the center to help in securing a circulation of air and to break the through mortar joint at this point.

32. The all-header course may be a feature of the architectural design, and made to have an attractive appearance. If preferred, however, some of the vertical joints in this

course may be blind joints, as shown on Plate X, and the header course can thus be made to have the appearance of alternate headers and stretchers, or all stretchers.

33. Exposed and Concealed Joist Support, Ideal Rolok-bak Wall.—On Plate X is shown the use of an all-header course as joist support. As in the case of the Ideal all-rolok wall, this course may be made an attractive feature of the design, with headers exposed. Headers may be placed in and out alternately, a band of three or four courses of headers introduced or other appropriate treatment employed.

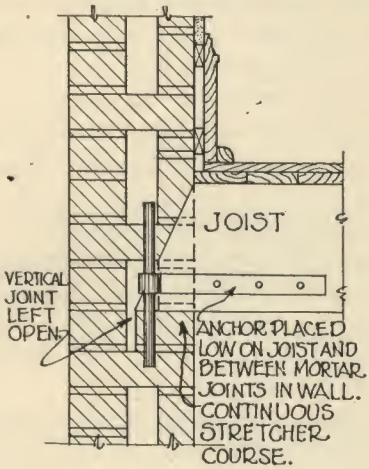


FIG. 157.—Concealed joint support forming fire stop. Ideal rolok-bak wall.

34. With the Ideal rolok-bak wall the all-header course is not, however, necessary to obtain a fire stop at the floor line. As shown in Fig. 157, a flat stretcher can be laid on the inside face of the wall at any point desired, to serve as a joist support and fire stop. The vertical joint should be left open as shown in order not to prevent the slow flow of air circulation.

35. Joist Anchors.—The usual type of joist anchor may be used with either Ideal all-rolok or Ideal rolok-bak walls, as shown in Fig. 157.

36. Window and Door Frames.—Stock window and door frames can be used in both types of Ideal walls.

37. It is possible to keep the face of the trim flush with the plaster with the Ideal all-rolok wall if desired, and thus produce a charming and unusual effect at little or no extra cost.

38. By making the brick opening a little wider and higher, and setting out the frame, a stock double-hung window used in the Ideal rolok-bak wall can be made to preserve the usual relation of the back of the frame being flush with the finished plaster. In this case, a wind stop is nailed to the back of the frame. This detail has much historic precedent.

39. Where the usual outside window reveal is preserved with the Ideal rolok-bak wall, a special backband will be required when a stock frame is used.

40. Supports over Openings.—In the plates, the inner and outer web are shown supported on steel angles but any of the standard methods may be employed. Openings may be arched, or a combination of an arch for the outside course and a wood lintel inside with relieving arch over, may be used.

41. Fire Stopping Window and Door Frames.—As shown on the plates, effectual fire stopping of all openings consists of brick chips slushed in as the wall goes up. This fire stopping need not be more than 1½ in. or 2 in. thick (see isometric drawing, Plate XII).

42. Nailing Blocks.—One-by-four or two-by-four nailing blocks may be built in Ideal walls at any point desired as the work progresses, to form a nailing base for the attachment of grounds.

43. Mortar and Joints for Ideal Walls.—Portland cement lime mortar should be used below grade; lime mortar may be used above grade.

44. All mortar joints in Ideal walls should be filled. The mason must take care to avoid dropping more mortar than can be avoided inside the wall cavity, in order not to defeat the purpose of the wall by affording contact with the inner and outer webs even at this point.

45. The bricklayer should consult "Brick—How to Build and Estimate" for more information on Ideal wall construction.

UNIT XI

CHIMNEYS AND FIREPLACES

1. Chimneys.—Although the brickwork in chimneys is frequently concealed from view, it is essential that this brickwork be thoroughly and conscientiously laid. A carelessly built flue, with joints not properly filled, might permit the escape of hot gases that would ignite inflammable material in the vicinity of the chimney, with the consequent destruction of the building.

2. The simplest form of chimney construction consists of a 4-in. wall inclosing a flue lining of burned clay laid in sections

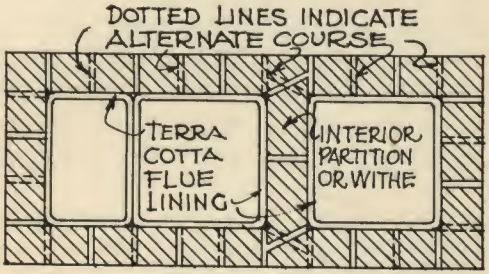


FIG. 158.—Plan showing bonding in chimney.

with joints full of mortar. Not more than two flues should be in the same chimney space. Where there are more than two flues each third flue should be separated by a "withe" or 4-in. brick partition. Flue linings should always be placed first and the brickwork built around it. Thoroughly fill all joints, including the space between the lining and the brickwork. Never build the brickwork first and drop the lining in afterwards. If the brickwork is 8 in. or more in thickness, the interior of the flue may be plastered with rich cement mortar instead of using tile. The plastered surface, being rougher,

offers more resistance to the draft than the smoother surface of the flue lining, however, and is likely to crack and fall off. In larger stacks, the hottest portion is sometimes lined with fire brick. Plastering the interior of a flue built with brickwork only 4 in. thick is very dangerous. If the plastering should fall off such a wall, there would only remain 4 in. of brickwork to protect the interior of the house. The expansion and contraction of the flue might to some extent disrupt the mortar between the bricks. Many fires actually have been caused by such construction. Especially to be condemned is the practice of building a flue of one thickness of brick laid on edge, or a total thickness of brickwork of only 2¼ in. Such a flue is dangerous whether or not it has clay flue lining.

3. Flue linings should start at least a foot below the first chimney opening, and be carried the entire height of the chimney and project several inches beyond the top in order to produce a good draft. The brickwork should be topped with a sharply sloping cap of cement or stone with the tile lining terminating 2 or 3 in. above. This will cause the air currents to take an upward turn, thus giving maximum draft. The chimney should be a foot or more higher than the highest section of the roof about it. There should be no connection between two or more flues in the same chimney, or smoke from one flue may pass through the opening and under certain conditions be blown down the adjoining flue and out into the room. To obtain the best draft, flues should be laid vertically without offsets; if offsets are necessary, their slope should never be greater than 30 deg. from the chimney proper, or eddy currents and the collection of soot will result. Great care should be taken to cut flue lining miters accurately and to fill all joints with mortar. An airtight chimney with no unnecessary openings will give the best draft. No rough edges or sharp corners should be left, as they will catch soot and in time may close up the flue. Chimney pots are sometimes added to the top of the chimney for decorative purposes.

4. The smaller and softer flue linings may be cut with a chisel and hammer more easily if placed on end and filled with sand. For larger and harder flue linings there is less

danger of breakage if they are stood on end, and the inside as well as the outside surfaces are chipped off by a downward blow of a bricklayer's hammer until the sides are thin enough to break off easily at the point desired. Many prefer the use of sand in all cases.

5. Chimneys should be supported by foundations, which are often built hollow below the lowest fireplace or flue connection so as to form an ash or soot pit, a clean-out door being built in at an appropriate height. Chimneys with little projection are sometimes supported upon corbeling. All wood construction should be kept clear of the chimney by at least 2 in. Do not frame any timber in a chimney wall.

6. A good mortar mixture for fireplaces consists of two parts of cement, one of lime, and three of sand. The brickwork of a free-standing chimney exposed to the weather should be laid in rich cement mortar. In building flues with offsets, some device should be used to keep the falling mortar and brick collecting at these points. Openings at these places are sometimes left to be bricked up later, a board being inserted in the opening and so sloped that the mortar will fall out of the chimney as it hits it. A bag filled with shavings is sometimes pulled up the chimney as the work progresses, catching all falling mortar.

7. The architect's drawings and specifications usually define just how flues and chimneys must be constructed. Their design must always be in accordance with local building ordinances. Boiler manufacturers will always give the size and height of flue required for the proper draft for boilers they manufacture. The American Society of Heating and Ventilating Engineers also issues data on flues and an excellent ordinance covering in detail the construction of chimneys may be had free of charge upon application to the National Board of Fire Underwriters, 76 William Street, New York City.

8. Large stacks for industrial purposes are constructed either square or round in plan. Circular chimneys require fewer brick for the same effective flue area and, as heated air travels upward in a spiral motion, are more efficient. In constructing large stacks the material hoist and scaffolding

are generally inside the stack. Outside scaffolding is sometimes used, especially for ornamental brickwork. All joints should be shoved full of mortar. Large chimneys are usually designed and their construction supervised by competent engineers.

9. Fireplaces.—The open fireplace is one of the oldest devices for heating the home. Even in steam-heated dwellings the fireplace, because of the pleasant associations attached to it, often finds a place. It may be made most artistic through careful design, workmanship, and selection of brick. The fireplace forms the center about which the decorative scheme of a room is built. The opening of the fireplace should be carefully proportioned. Tables giving correct combinations of width, height, and depth are available (see "Brick—How to Build and Estimate").

10. The opening is spanned by an arch or a steel lintel. All forms of arches are used to meet varying requirements. An entire course of the brick used for facing over the arch is often laid out without mortar before the fireplace is built so as to make the width come exactly right, preventing the cutting of the brick to irregular lengths.

11. The hearth, both front and back, may be laid in the same brick that is used for the mantel but tile are frequently used. In ordinary construction with wood joists the front hearth is supported by a trimmer arch laid upon a center extending from a corbel to a joist header. If the use of a corbel would cause a projection to show on the ceiling of the room below, the skewback may be made by setting in two courses not less than 1 in. deep. The lower the spring line of the trimmer arch the better; there is certain to be some shrinkage of the wooden joists. The space between the top of the arch and the hearth should be filled with concrete. An ash dump is generally built into the back of the hearth.

12. The back and sides of the fireplace are sometimes laid in fire brick, although the same brick used for the mantel may be employed. In order that the fireplace may throw the maximum of heat into the room the first few courses of the back may be vertical but from there on the work should

slope or curve in toward the front of the fireplace. This causes the heat to radiate directly from the heated brickwork into the room and throws the throat of the fireplace forward, making a smoke shelf, the latter preventing down drafts. The narrowing of the throat increases the air velocity at this point and produces the desired draft. A metal damper should be inserted at the throat. Some excellent metal throats and dampers made in one piece are on the market. These automatically assure the proper forming of the throat. Above the smoke shelf the opening is gradually reduced in size by corbeling to meet the flue, and this is called "gathering." Gatherings should be plastered smooth to prevent soot from accumulating. The brickwork should be at least 8 in. thick up to the point where it joins the flue lining. If a fireplace projects only a short distance from the main wall, it may be supported by corbeling out from the wall. Generally, however, a wall to support the fireplace should be built up from a proper footing. The space between the main wall and supporting wall of the fireplace may be left hollow to serve as an ash pit.

13. The chimney breast is the section of the chimney above the mantel. To provide a more pleasing design, the breast is often furred out beyond the real masonry to preserve the same width and projection as the fireplace below. The designing of fireplace and mantel affords great scope for the talent of the architect, whose design may call for the use of brick, stone, tile or wood in combination, or some masonry material exclusively. Brick mantels are designed with every variety of bond and special arrangement of brick to give the effect desired.

14. In constructing a fireplace, the rough brickwork only is first built until after the plastering is finished, in order to keep the brickwork free from plaster stains and other possible injury while the building is being erected.

UNIT XII

ARCHES AND LINTELS

1. Arch.—An arch is a mechanical arrangement of building materials arranged in the form of a curve, which preserves a given form when resisting pressure and enables it, supported by piers or abutments, to carry weights and resist pressure.

2. Lintel.—A lintel is a horizontal member spanning an opening. Lintels supporting brickwork may be of steel, stone, reinforced brickwork, reinforced concrete, etc.

3. Soffit.—An under surface.

4. Uses.—Arches and lintels may be used over windows, doors, and all other openings in a wall or between piers or other supports. Arches are also constructed to resist side and upward pressure.

5. Abutment.—The supporting surface from which an arch springs.

6. Skewback.—An inclined surface from which an arch springs.

7. Extrados or Back.—The exterior or convex curve forming the line of the arch farthest from the center. The term is opposed to intrados, or concave side.

8. Intrados.—The concave curve of an arch, the side nearest to the center. The term is opposed to extrados, or convex side.

9. Crown.—In architecture, the uppermost member of a cornice. In the bricklaying trade, however, the highest portion of an arch is frequently called the "crown."

10. Key.—The stone or brick placed in the center of an arch.

11. Springers.—The stones or bricks in an arch adjacent to the abutment. The lowest stone of a gable is sometimes called a springer.

12. Spring Line or Spring.—The line or point at which the arch begins.

13. Span.—The distance between supports. Applied to a beam, girder, arch, truss, etc.

14. Rise.—The distance through which anything rises, such as the greatest distance between a line drawn between the spring lines of an arch and its intrados; the measurement being taken at right angles to the line.

15. Jamb.—The lining of a door, window, or other aperture. The jamb of a door or window outside the frame is termed the "reveal."

16. Haunch.—A point about midway between the crown and the spring line is known as the "haunch."

17. Spandrel.—The space between an arch or curved brace and the horizontal "label," beam, etc. over the same. In a steel or reinforced concrete framed building in which the windows occupy the major portion of the horizontal distance between piers, the section of the wall between the floor line and the sill is often called the "spandrel."

18. Reveal.—In a masonry wall the exposed masonry between the face of the wall and the frame set in an opening in the wall is called the "reveal."

19. Radius.—Of an arch is the distance measured in a straight line from the intrados to the center of the circle of which the arch forms a part.

20. Gaged Arch.—An arch in which the bricks are carefully cut or rubbed to the proper shape so that the radial and horizontal mortar joints will be of an even width.

21. Rough-axed Arch.—An arch constructed of brick roughly cut to shape by the trowel, scutch, or the cutting end of the brick hammer.

22. Plain Brick Arch.—This is constructed of ordinary brick without any cutting or gaging. The mortar joints in these arches are necessarily wedge-shaped.

23. Laying Out or Centering an Arch.—An arch is constructed on a temporary support or **center,** which is left in position until the mortar has set. The center is usually constructed of wood, and is built and placed by the carpenter.

24. The correct curve of the arch must be known before the center can be constructed. The radius, rise, location

of centers of radius, etc. of simple arches are generally placed upon the working drawings in feet and inches by the architect, in addition to the working drawings showing such arches to scale. More complicated arches, such as three-center, five-center, elliptical, etc. arches, are drawn to scale upon the elevations, and in addition larger scale drawings are generally furnished and sometimes full-size drawings are made. All these must be carefully followed. Simple curves are struck

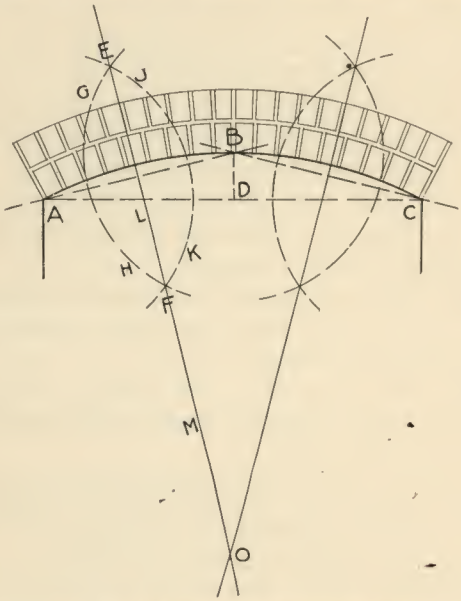


FIG. 159.—Laying out segmental arch.

upon a suitable piece of lumber laid on the floor with a piece of string looped over a nail driven at the correct point and a pencil at the other end. If the string is tied tightly to the nail, it will wind up on the nail as the curve is struck and decrease the radius. Tie the string as closely to the point of the pencil as possible to avoid a wavy line. A beam compass is much more accurate than the nail and string method generally used. Where a full-size detail showing the curve of an arch is furnished, this should be pasted upon a piece of lumber, and

the curve carefully followed with a saw. This is used as a template. A semi-circular arch is struck with a radius equal to one-half of the span, the circle being struck from the center of the span; the radius corresponding to the rise of the arch.

25. To lay out a segmental arch with the aid of a compass, the following procedure should be followed (Fig. 159).

a. Bisect the line *AC* at *D*. At *D* erect a perpendicular line marking upon it the rise *B*.

b. Set the compass to a distance of less than one-half the span.

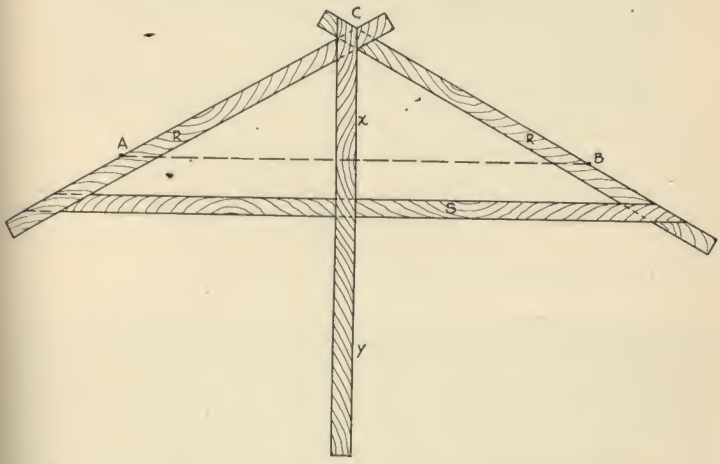


FIG. 160.—Apparatus for drawing the curve of a segmental arch.

c. Strike two arcs *JK* and *GH*, with the same radius from centers *A* and *B*. Repeat on opposite side.

d. Through the intersections *E* and *F* draw a line *ELM* extending it far enough to intersect a line drawn through the corresponding arc intersections on the other side of the center.

e. The point *O* is the center from which the arch is struck, the radius being *OA* or *OB*.

26. A practical method to obtain the correct curve for a segmental arch when the required rise is known is as follows:

27. Let *A B* be the span, *C* being the rise. Drive two nails at *A* and *B* leaving the heads projecting. Take two light wooden

strips *RR* and place them as shown, one against *A*, the other against *B*, arranged so that their intersection is at *C*. Nail the strips at the intersection and add other pieces *S* and *XY*,

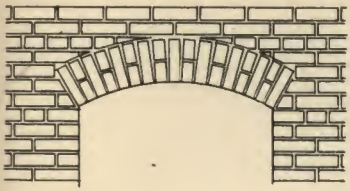
FIG. 161.—A flat gauged arch.

nailing all together. Then keeping the edges of the triangle against *A* and *B*, swing the triangle around, holding a pencil at *C*, which will then trace the required curve.

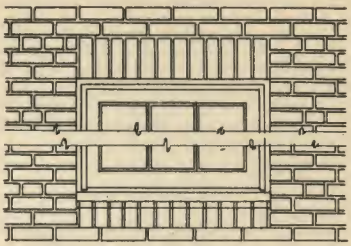
FIG. 162.—A gauged flat arch with camber.

28. French, Jack, or Flat Arch.—In a gaged French or "jack" arch, the radial joints are of uniform width for their entire length. This is accomplished by having the brick rubbed or cut to wedge shape with horizontal surfaces at the bottom and top of each brick or by the use of specially made

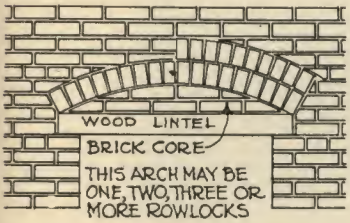
brick. A more inexpensive type of jack arch may be constructed in which the brick are not rubbed to wedge shape but



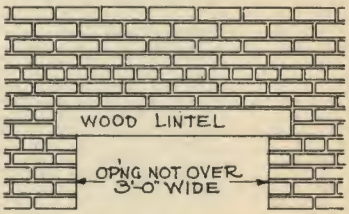
SEGMENTAL ARCH BONDED OR "LACED"



ELEVATION OF WINDOW WITH BRICK SILL AND SOLDIER COURSE OVER STEEL LINTEL



WOOD LINTEL AND RELEIVING ARCH SUPPORTING BACKING



WOOD LINTEL SUPPORTING BACKING

INEXPENSIVE TYPE OF FLAT OR "JACK" ARCH. BRICKS NOT RUBBED TO WEDGE SHAPE HORIZONTAL JOINTS AT RIGHT ANGLES TO RADIUS OF BRICK. BRICK RUBBED OR ROUGH AXED AT TOP AND SOFFIT ONLY

BETTER TYPE OF FLAT OR "JACK" ARCH. BRICK RUBBED TO WEDGE SHAPE AND RUBBED TO FORM HORIZONTAL JOINTS TOP AND BOTTOM OF EACH BRICK. THIS IS TERMED A "GAUGED" ARCH

FIG. 163.

are rubbed at the extrados and soffit only. This makes the horizontal joints between the ends of the brick come at right

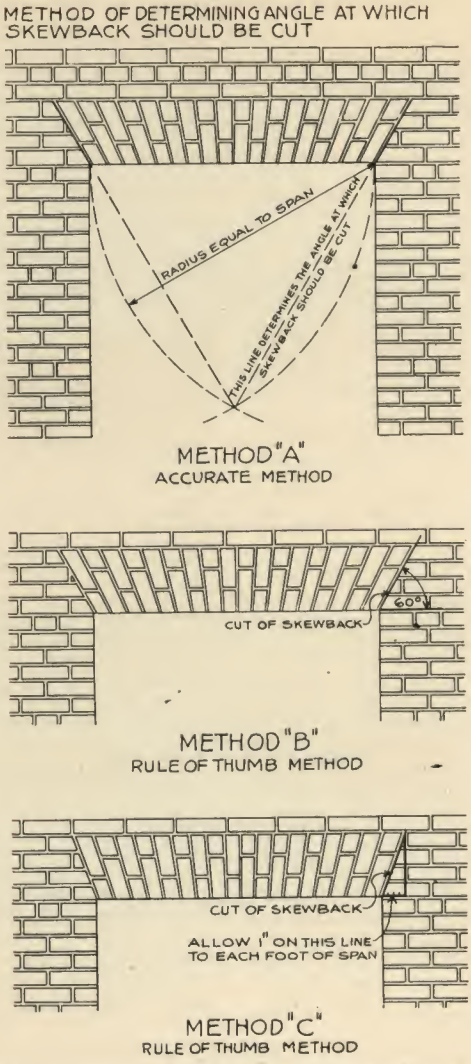


FIG. 164.—Various methods of determining angle of skewbacks.

angles to the radius upon which the brick are laid and the radial joints will of necessity be wider at the top than at the bottom, the mortar joints making up the difference. A jack arch, although theoretically a true arch, in practice is weak and should be supported on steel lintels for all openings exceeding 2 ft. in width. Inasmuch as a perfectly horizontal soffit, especially a wide one, appears to the eye to sag in the middle, a slight camber may be formed in the soffit to correct this (Fig. 122).

29. Three methods for determining the angle at which the skewbacks may be cut are: *a*. Use the span as a radius

FIG. 165.—Segmental arches on a near wall. Note also squint quoins, pigeonhole type.

and strike intersecting arc through the springing points, and draw lines through the springing points from the center. *b*. Cut at a 60 deg. angle with the span. *c*. Erect a perpendicular upon a horizontal line drawn through the springing points at a point as many inches back of the springing point as there are feet to the span; this perpendicular intersecting the extrados.

30. Segmental Arch.—The segmental arch is one of the strongest forms of arch. The abutment must, of course, have

sufficient weight and mass to resist the side thrust. The rise given a segmental arch will depend partly upon the load and partly upon the design of the building. It is common practice to make the rise one-eighth of the span. One inch rise for each foot of span is another rough rule. Segmental arches may be constructed of alternate headers and stretchers where appearance is a factor, or of courses or "rings" of rowlocks. Unless special brick are used or the brick are gaged or rough axed, the mortar joints will of necessity be wider at the extrados than at the intrados.

FIG. 166.—Semi-circular arches.

31. Semi-circular or Roman Arch.—The semi-circular arch is one of the strongest forms of arch. It may be constructed of one or a number of courses or "rings" of rowlocks, or of stretchers, or a combination of both. The brick may be gaged or rough axed, or constructed of plain brick, in which case there will be a difference in the width of the joint at extrados and intrados.

32. Three-center Arch.—To construct the curve (Fig. 168) for a three-center arch, let AC be the span and B the required rise. The radius of the side arcs AF': CF is also given. Draw BD perpendicular to AC. Lay off AG, CI, and BH, each equal to the required radius of the side arcs. Join G and H, bisect-

ing the line *GH* by a perpendicular. The intersection of the perpendicular with *BD* gives the center for the central portion of the curve, the exact length of which is obtained by joining *D* and *G*, also *D* and *I*, and extending the lines. From centers

FIG. 167.—A deep semi-circular arch such as this is frequently called a "barrel" arch.

G and *I* describe the arcs *AF* and *CF* respectively. From center *D*, with radius *DF* describe the arc *F'F*.

33. Very often the architect will correct with a free-hand curve the slight apparent flatness about the points *F'* and *F*.

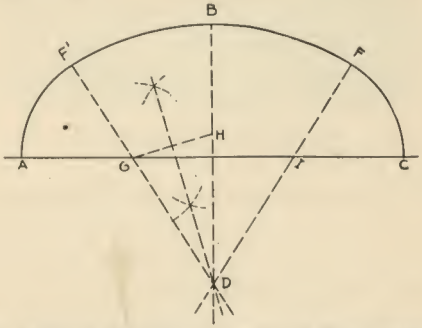


FIG. 168.—Method of laying out curve of three centered arch.

34. Elliptical Arch.—Special care is necessary in forming an elliptical arch correctly to obtain a good curve. A poor curve is very noticeable with an arch of this type and is far too fre-

quently seen. An ellipse is the section of a cone cut by a plane passing obliquely through it.

35. There are many methods of describing an ellipse. Two very practical methods are given here. In each case the span and rise are given.

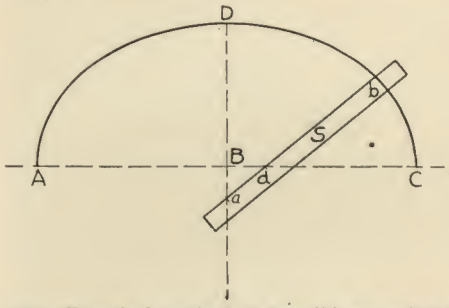


FIG. 169.—Practical method of describing an elliptical arch.

Method 1. Draw the chord AC, bisect it at B and draw the line DB, the distance DB equaling the rise. Project the line some distance below the chord. Take a strip of wood S and mark on it the distance ab equal to AB and db equal to DB.

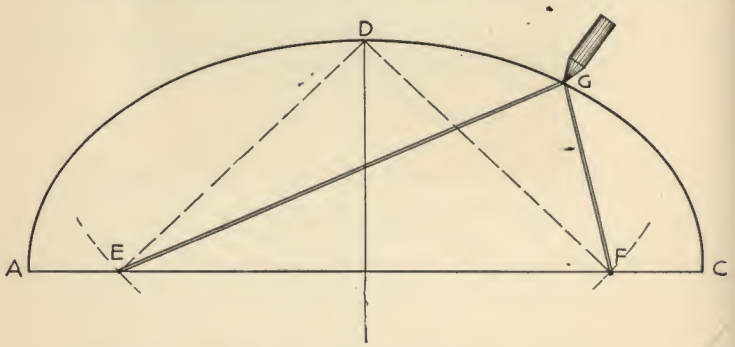


FIG. 170.—Elliptical arch described with string and pencil.

Begin the curve by placing the point b at A, with ab' on the line of the chord. Move the straightedge, keeping d on the long axis and a on the short axis. Make dots frequently on the line D. Through them draw the ellipse (Fig. 169).

Method 2. With radius equal to AB and from D as a center describe an arc cutting AC at E and F. Drive a nail at E another at F and a third at D with the heads projecting. Loop a cord around the three nails. Pull out the nail at D. Then place a pencil point inside the loop and starting at A or C draw the curve, keeping the loop tight (Fig. 170).

36. Pointed Arch.—The pointed arch, commonly referred to by the craftsman as a "Gothic" arch, is mostly used on

FIG. 171.—An elliptical arch.

Gothic buildings. This arch is struck from two or more centers and is pointed at the center.

37. Supporting or Relieving Arch.—Over openings 3 ft. wide or less, such as door and window openings, a wood lintel generally supports the backing. The brickwork will practically support itself after the mortar sets and will not fall even if the lintel decays or burns. For openings greater than 3 ft. in width, a wood lintel is placed as for narrower openings, on which is built brickwork shaped to form a permanent center

FIG. 172.—Arch with slight point at center.

for a segmental arch called a relieving arch, constructed of one or more rings of rowlock headers according to the span and load to be carried. The span of the relieving arch must not be less than the length of the wood lintel. When carrying very heavy loads the brick should be "laced," that is, bonded for several courses by rowlock headers at intervals about the arch. The brick on the outer tier are frequently supported by steel lintels, as described in the following paragraph (Fig. 163).

38. Lintels.—A steel lintel of a size proportionate to the load to be carried is frequently used to carry loads over openings. The lintel should have at least a 4-in. bearing surface on each end. For a soffit over a window or door the lintel generally supports the outside portion of the brickwork the depth of the reveal. A steel lintel is generally used to carry flat arches and soldier courses over openings. The soldier course, to give the best effect, should not be wider than the span. All parts of the metal that will be concealed in the masonry should be thoroughly painted with red lead or graphite before the lintels are placed. The entire thickness of the wall is sometimes supported upon a steel lintel.

39. Preliminary experiments upon reinforced brick lintels have been highly encouraging. By the use of reinforced brickwork the entire reveal including the head of the opening will show a brick surface; thus doing away with the rather unsightly appearance of a steel lintel.

40. Methods of Constructing an Arch.—In constructing arches, wooden centers are made and set by the carpenters. It is good practice, especially with wide arches, to support the centers upon wedges which are gradually driven out when the centers are removed. This allows the arch to assume the load gradually. "Striking" the center refers to the operation of transferring the weight previously supported by the center to the arch. The centering is not struck until the mortar has set. In constructing an arch, start at the skewback and work toward the center, the key or middle brick being the last one laid. The job should be measured before starting in order to determine how many brick will be necessary and where the key will come. This enables the bricklayer to so space his mortar

joints that it should be unnecessary to do any additional cutting or splitting to the key brick. Sometimes the bricklayer places the brick dry on the center to make sure that the joints will work out right. It is a proof of bad and careless workmanship to have to split the brick in order to complete the arch. A true arch must have an odd number of courses in order to bring the key at the center. An arch with an even number of brick is known to the trade as a "she."

41. Use Full Bed Joints.—Arches must be laid so that the bed joints are full of mortar. Otherwise, the work may bulge at the center. When laying an arch, use a straightedge frequently so as to detect any tendency of the arch to bulge.

42. Selection of Arches and Lintels.—For ordinary work, for arches over windows and doors with a 4-in. reveal, a segmental arch the thickness of the wall is probably the lowest in cost. A soldier course set upon a steel lintel is very popular; it costs little more than the segmental arch and makes a better looking job in many cases. The outer tier is frequently carried up directly from the steel lintel without a soldier course. A stone lintel (frequently used for decorative effect) should be supported by a steel lintel if the stone has not sufficient cross-sectional area to carry the load. To give the best effect, stone lintels should blend or contrast in a pleasing way with the brickwork of the building, and should be in proportion to the size of the opening and to the size of the building itself. An arch generally carries that portion of the wall above which would be contained within an equilateral triangle having for its base the span of the arch, except in cases where the level of the floor joists or other load supporting member comes close to the arch. The better the fit of the brick used in an arch and the more uniform the width of the joint, the stronger the arch will be, and the better its appearance.

UNIT XIII

EFFLORESCENCE

1. Definition.—After a job has been completed, there sometimes appears upon the face of the wall a white film which dries in irregular patches, spoiling the appearance of the brickwork. This is known as efflorescence or "whitewash."

2. Causes.—When masonry contains soluble salts, and these salts are dissolved by moisture or water (such as the water used in wetting the brick and in mixing the mortar); the solution may be carried to the face of the wall, when the water will evaporate and leave the salt on the face of the wall in the form of crystals. Any type of masonry is liable to show efflorescence. The salts may be present in the wall for a variety of causes.

a. When common salt or calcium chloride is used in winter construction to lower the freezing point of the mortar, efflorescence is very likely to occur. A bad case of efflorescence on stonework has been known to result from melting out with salt some lewis holes that were full of ice; the efflorescence making its appearance several months afterwards.

b. A leak from a pipe containing liquid or moisture leaking from some other source may wet masonry which originally contained no soluble salts, the water from the leak carrying with it enough of this material to cause efflorescence.

c. Water seeping into a basement wall in very wet ground may carry soluble salts from the soil and deposit them in crystals; or porous masonry just above grade may show efflorescence caused by the masonry drawing up salt-laden moisture from the ground by capillary attraction, the moisture drying out on the face and leaving the salt crystals.

d. Lime or cement used in the mortar may contain soluble impurities.

e. If the mortar sand is not clean and contains loam or other impurities, it may also contain soluble salts.

f. The mortar may be mixed with dirty water containing soluble impurities.

g. The brick may contain soluble impurities which with some clays occasionally result from the chemical breaking down of the original rock. These impurities are sometimes made non-soluble by the addition of barium carbonate to the clay. This is an expensive process, however.

3. Methods of Removing Efflorescence.—Efflorescence generally disappears if simply left a few weeks or months to the weather. A newly built wall soon dries out and unless the masonry is again soaked with water the efflorescence will not reappear. Efflorescence may be removed with a scrubbing brush and water. Some masons add a little muriatic acid to the water—not more than 1 pt. to 4 gal. of water. Wash the muriatic acid off thoroughly, scrubbing the wall with clean water. It is a mistake to assume that waterproofing a wall will stop efflorescence, unless the wall is thoroughly dry throughout when the waterproofing is applied and unless no moisture can reach the masonry on any side other than that waterproofed.

PART IV

UNIT XIV

TO THE INSTRUCTOR OF APPRENTICES

The prospect of actually laying brick—of having the trowel in his own hand—is one compelling reason why many boys are attracted to this ancient craft. Do not dull the boy's enthusiasm by making him do theoretical work first. Give him brick, trowel, and mortar at once and let him "go to it." Make the theory of the trade incidental to the job itself but a definite part of it. This will maintain interest from the start.

The following Trade Problems have been compiled for the purpose of aiding the instructor in starting the boy upon practical work at once. By having the pupil read the numbered paragraphs in the book listed under each problem and by keeping a record of his work on a job card similar to the one shown on the next page, a complete history of the apprentice's progress will be available.

It is realized that changes in, and additions to, the problems listed will be both desirable and necessary and it is not expected that the instructor will attempt to assign all of the problems in the same order in which they are listed in this book. The suggestions offered should, however, form a basis for the organization of an apprentice training group, and the elimination or extension of parts of the content is a matter in which each instructor should use his own judgment.

JOB CARD

UNIT NO.....

Name.....

Trade Test Grade

Questions answered					Type jobs completed			
Poor	Fair	Good	Excel-lent	No.	Poor	Fair	Good	Excel-lent
				1				
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
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				28				
				29				
				30				
				31				
				32				
				33				
				34				
				35				
				36				

For convenience, this book has been divided into *Units*, such as Mortar, Jointing, etc. All of these *Units* will be found listed at the back of the book together with the *Questions* which should be answered, and the *Type Jobs* which should be completed under each *Unit*.

A card should be filled out by the apprentice for each *Unit* and punched by the teacher, thus recording the quality of each type job completed and the correctness of the answer to each question.

TRADE PROBLEMS

Problem 1:

Mix a batch of lime mortar, using lump lime, stacking the mortar and tempering it.

Read paragraphs:

Unit III—1 through 23, 39 through 40, 45 through 46.

Unit IV—20 through 27.

Answer questions:

Unit III—1 through 14, 29, 33, 34.

Unit IV—19, 20 through 25, 30.

Perform type jobs:

Unit III—1 through 4, 6.

Instructor's note: Enter grades upon the job cards for the *Questions* answered and *Type Jobs* completed under each Unit referred to. The numbered *Questions* and *Type Jobs* under each Unit will be found in detail at the back of the book. It is, of course, impossible to give every boy the job of mixing mortar at the beginning of his work. In all of these jobs the work is so arranged that the instructor may give the work at the most opportune time and enter his grades upon the job cards at the time the work is done. By this device the instructor may have a different group of boys mix the mortar each time that a new batch is needed. Eventually, each boy will have had the experience of slaking lime, and mixing mortar. For ordinary practice work in laying brick where the job is to be torn down, a slow-setting mortar should be used. Each boy should be thoroughly informed, however, before leaving the school, in regard to methods of mixing the standard mortars used in the trade, although he will probably never be called upon to do the mixing himself. In some cases the mortar may be used for permanent jobs to be done about the school building. In cases where the work must be constantly torn down, once the pupil has had the practice of mixing mortar, a group demonstration may be substituted for actual experience in the mixing of cement mortars, etc.

Problem 2:

Mix a batch of lime mortar, using hydrated lime.

Read paragraph:

Unit III—41.

Answer questions:

Unit III—15, 22, 30.

Perform type jobs:

Unit III—5.

Problem 3:

Mix a batch of 1:1:6 cement lime mortar.

Read paragraphs:

Unit III—24 through 28.

Unit III—42 through 44.

Answer questions:

Unit III—16, 17, 18, 19, 20, 21, 31, 32.

Perform type jobs:

Unit III—8.

Problem 4:

Mix a batch of 1:3 cement mortar, replacing 10 per cent of the cement with hydrated lime or lime putty.

Read paragraphs:

Unit III—29 through 38, 51 through 55.

Answer questions:

Unit III—23, 24, 25, 26, 27, 28, 36.

Perform type jobs.

Unit III—9.

Problem 5:

Lay a section of an 8-in. wall, 2 ft. high, in running bond, with metal ties, using common brick and lime mortar, with a rough-cut joint, by the stringing mortar method, toothing the ends.

Read paragraphs:

Unit I—1 through 4.

Unit IV—1 through 5, 7, 22, 27, 28, 29, 30.

Unit V-A—1 through 8, 11a.

Unit VII—1 through 3, 6.

Unit IX—1 through 14, 28.

Unit X-A—10.

Answer questions:

Unit I—1, 2.

Unit IV—1, 2, 3, 4, 5, 7, 26, 28.

Unit V—1, 2, 3, 4, 5, 6, 8, 9.

Unit VII—1, 2, 3, 6.

Unit IX—1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 19, 20, 21.

Unit X—1.

Perform type jobs:

Unit V—1.

Unit VII—3.

Unit IX—1, 2, 3, 4.

Unit X—1.

Problem 6:

Lay a corner of an 8-in. wall with a struck joint by the pick and dip method, using a clipped running bond, making a shoved joint and racking the ends.

Read paragraphs:
Unit I—5 through 8.
Unit IV—6, 8, 9, 10, 11, 14, 15, 16, 17, 18, 49.
Unit V-A—11*b* and *c*, 12.
Unit VII—4.
Unit IX—15, 17, 33, 34.
Unit X-A—12.
Answer questions:
Unit I—4, 5, 6.
Unit IV—6, 8, 9, 10, 11, 14, 15, 16, 17, 43.
Unit V—10, 11.
Unit VII—4.
Unit IX—10, 12, 27.
Unit X—2.
Perform type jobs:
Unit V—2.
Unit VII—1.
Unit IX—5, 6.
Unit X—2.

Problem 7:

Raise a corner on the 8-in. wall of problem 6, assuming that the wall to be constructed is a story high, using common or American bond, with a weathered joint, giving the correct roll to the brick, and plumbing the corner carefully.

Read paragraphs:
Unit IV—20, 31.
Unit V-A—13.
Unit VII—5.
Unit IX—23 through 26, 29, through 32.
Answer questions:
Unit IV—29.
Unit V—12.
Unit VII—5.
Unit IX—18, 22, 24, 25, 26.
Perform type jobs:
Unit V—3.
Unit VII—2.
Unit IX—10, 11, 12, 13.

Problem 8:

Lay a corner of an 8-in. wall, 2 ft. high, in English bond with a flush-cut joint, with a course of rowlock headers, capping the wall, using black mortar.

Read paragraphs:
Unit I—5, 15, through 18.
Unit III—47 through 50.

Unit V-A—8 through 10, 14.
Unit VI—1, 2.
Unit VII—7.
Unit IX—35, 36.

Answer questions:
Unit I—3, 13.
Unit III—35.
Unit V—7, 13.
Unit VI—1, 2.
Unit VII—7.
Unit IX—28, 29.

Perform type jobs:
Unit III—7.
Unit V—4.
Unit VI—1.
Unit VII—4.
Unit IX—14, 15, 16.

Problem 9:

Lay a corner of an 8-in. wall, 2 ft. high, with a raked joint, in English cross bond, with a course of rowlock stretchers across the bottom, and a saw-tooth course for the second course of brick.

Read paragraphs:
Unit V-A—15.
Unit VI—3.
Unit VII—8.
Unit X-A—50.

Answer questions:
Unit V—14.
Unit VI—3, 7.
Unit VII—8.

Perform type jobs:
Unit VI—2, 6.
Unit VII—5.

Problem 10:

Lay a corner of an 8-in. wall, 3 ft. high, in garden wall bond, with a stripped joint, with a soldier course across the bottom of the wall, and a 12-in. bonded course across the top.

Read paragraphs:
Unit V-A—21.
Unit VI—4, 5.
Unit VII—9.

Answer questions:
Unit V—15.
Unit VI—4, 6.

Unit VII—9.
Perform type jobs:
Unit V—6.
Unit VI—3, 5.
Unit VII—6.

Problem 11:

Lay a corner of an 8-in. wall, 2 ft. high, in Dutch cross bond, with a V joint, using enameled brick for the face of the wall.

Read paragraphs:
Unit I—9.
Unit IV—13.
Unit V-A—10, 15.
Unit VII—10.
Unit X-A—53.
Answer questions:
Unit I—7.
Unit IV—13.
Unit V—16.
Unit VII—10.
Unit X—39.
Perform type jobs:
Unit V—7.
Unit VII—7.

Problem 12:

Lay a corner of a 12-in. wall, 3 ft. high, with a beaded joint, in double Flemish bond, blocking the ends, using impervious brick and laying a dentil course next to the top course of brick.

Read paragraphs:
Unit I—12.
Unit IV—23, 32.
Unit V-A—16, 17.
Unit IX—16, 41.
Unit X-A—13, 49.
Answer questions:
Unit I—9, 10.
Unit V—17.
Unit VI—8.
Unit IX—31.
Unit X—3.
Perform type jobs:
Unit V—8.
Unit VI—7.
Unit IX—19.
Unit X—3.

Problem 13:

Lay a section of a 12-in. wall, 2 ft. high, in single Flemish bond, with a sailing course running across the center, backing the wall with open joints.

Read paragraphs:
- Unit V-A—16, 17.
- Unit IX—20.
- Unit X-A—48.

Answer questions:
- Unit V—18.
- Unit IX—15.
- Unit X—7.

Perform type jobs:
- Unit V—9.
- Unit IX—9.
- Unit X—31.

Problem 14:

Lay a section of a 12-in. wall, 3 ft. high, facing the wall with double-stretcher Flemish bond, backing the wall with common bond and corbeling out the top of the wall for a distance of 10 in.

Read paragraphs:
- Unit V-A—18, 19.
- Unit X-A—51, 52, 57.

Answer questions:
- Unit X—8.

Perform type jobs:
- Unit V—10.
- Unit X—5.

Problem 15:

Lay a section of an 8-in. curved wall, 2 ft. high, with a radius of 6 ft. using Flemish spiral bond.

Read paragraph:
- Unit V-A—20.

Answer questions:
- Unit V—19.

Perform type jobs:
- Unit V—11.

Problem 16:

Lay a section of a garden walk in herringbone pattern (see Fig. 72).

Read paragraphs:
- Unit V-A—23.
- Unit X-A—45.

Answer questions:
- Unit V—20.
- Unit X—17.

Perform type jobs:
Unit V—12.

Problem 17:

Lay a section of a garden walk in diagonal pattern.
Read paragraphs:
Unit II—7, 8, 9.
Unit V-A—24.
Answer questions:
Unit V—21.
Perform type jobs:
Unit V—13.

Problem 18:

Remove efflorescence and tuck point an old wall.
Read paragraphs:
Unit VIII—1, 2, 3.
Unit XIII—1, 2, 3.
Answer questions:
Unit VIII—1, 2, 3.
Unit XIII—1, 2, 3.
Perform type jobs:
Unit VIII—1, 2.
Unit XIII—1.

Problem 19:

Lay a section of a 12-in. wall, 5 ft. high, backing it with hollow tile and laying a panel upon the face of the wall in block pattern, using surface tile for decorative inserts and capping the wall with a cornice of ornamental terra cotta.

Read paragraphs:
Unit II—1, 2, 6, 10, 11, 12.
Unit V-A—25.
Unit VI—6, 7.
Unit X-A—46.
Answer questions:
Unit II—1, 2, 3, 4.
Unit V-A—22, 23.
Unit VI—5.
Unit X—5.
Perform type jobs:
Unit II—1, 2, 3.
Unit V—14, 15.
Unit VI—4.

Problem 20:

Lay a section of a 16-in. foundation, 3 ft. high, including the footing, with a grouted joint and with the outside of the wall moisture-proofed according to one of the methods described in the paragraphs referred to.

Read paragraphs:
Unit II—13.
Unit IX—18.
Answer questions:
Unit IX—13.
Unit X—25, 26, 31.
Perform type jobs:
Unit IX—7.
Unit X—18, 23.

Problem 21:

Lay a 16-in. wall in common bond 3 ft. high, using a slushed joint, inserting nailing blocks for a baseboard, leaving a dry joint and inserting a lath as a nailing base for furring, and leaving a chase 8 in. wide by 4 in. deep.

Read paragraphs:
Unit IX—19, 21.
Unit X-A—20, 33.
Answer questions:
Unit IX—14, 16.
Unit X—4, 14.
Perform type jobs:
Unit IX—8, 20.
Unit X—4, 11.

Problem 22:

Lay a fire wall with filled joints, changing from a 12-in. to an 8-in. wall, supporting anchored fire-cut joists. Beam fill between joists to level of underside of finished floor to form a fire stop.

Read paragraphs:
Unit IX—22.
Unit X-A—8, 9, 19, 21 through 23, 30, 31.
Answer questions:
Unit IX—17.
Unit X—29, 30, 34, 35, 38, 40.
Perform type jobs:
Unit X—22.

Problem 23:

Lay a section of a 12-in. wall, 2 ft. high, with fire brick in fire clay.

Read paragraphs:
Unit I—10.
Unit IX—37 through 40.
Answer questions:
Unit I—8.
Unit IX—30.
Perform type jobs:
Unit IX—17.

Problem 24:

Lay a section of a 12-in. furnace wall, 2 ft. high, using silica brick without mortar.

Read paragraphs:
- Unit I—10.
- Unit IX—38, 39.

Answer questions:
- Unit I—8.
- Unit IX—32.

Perform type jobs:
- Unit IX—18.

Problem 25:

Inclose a steel column in porous brick.

Read paragraphs:
- Unit I—14.
- Unit X-A—18.

Answer questions:
- Unit I—12.
- Unit X—37.

Perform type jobs:
- Unit X—26.

Problem 26:

Lay a corner of an 8-in. garden wall, the wall extending 4 ft. each way from the corner, with a 12 in. by 12-in. gate post at each end, one to be hollow and the other solid. (Note that the corner acts in the same way as a pilaster to increase stability.)

Read paragraphs:
- Unit IV—19.
- Unit X-A—6, 41, 42, 44.

Answer questions:
- Unit IV—18.
- Unit X—18, 20, 27.

Perform type jobs:
- Unit X—13, 15, 19, 20.

Problem 27:

Lay a section of an 8-in. wall in common bond about 3 ft. high with a pilaster 12 in. wide by 4 in. deep in the center of the wall and lay the wall with an obtuse external angle at one end.

Read paragraphs:
- Unit V-A—26.
- Unit X-A—7.

Answer questions:
- Unit X—15, 28.

Perform type jobs:
- Unit X—12, 21.

Problem 28:

Lay a corner of an Ideal wall four courses each in the following bonds: 12-in. wall rolok-bak, 12-in. wall all-rolok type 1, 12-in. wall all-rolok type 2, 8-in. wall rolok-bak, and 8-in. all-rolok.

Read paragraph:
Unit X-A—34.
Unit X-B—1 through 45.
Answer questions:
Unit X—21, 22.
Perform type jobs:
Unit X—16.

Problem 29:

Veneer a section of a frame dwelling, nogging the space between the studs.

Read paragraphs:
Unit X-A—32, 35 through 38.
Answer questions:
Unit X—23, 24.
Perform type jobs:
Unit X—17, 32.

Problem 30:

Lay a flight of three steps.

Read paragraph:
Unit X-A—43.
Answer questions:
Unit X—19.
Perform type jobs:
Unit X—14.

Problem 31:

Lay a section of a manhole.

Read paragraph:
Unit X-A—55.
Answer questions:
Unit X—33.
Perform type jobs:
Unit X—24.

Problem 32:

Lay a section of a fireproof brick arch floor.

Read paragraphs:
Unit X-A—17.
Answer questions:
Unit X—36.
Perform type jobs:
Unit X—25.

Problem 33:

Add to the thickness and length of an existing 12-in. wall.

Read paragraphs:

Unit IV—12.
Unit X-A—11, 14 through 16, 39, 40.

Answer questions:

Unit IV—12.
Unit X—41, 42, 43, 44.

Perform type jobs:

Unit X—27, 28, 29.

Problem 34:

Lay a section of an 8-in. wall bricking in a steel casement window, forming a brick sill and a plain jack arch over a steel lintel, the backing being supported on a second steel lintel.

Read paragraphs:

Unit IV—33 through 38.
Unit X-A—24, 25, 27, 28.
Unit XII—1 through 23, 28 through 29, 38 through 42.

Answer questions:

Unit IV—31, 32, 33, 34.
Unit X—9, 10, 12.
Unit XII—1, 2, 3, 4, 5, 7, 14, 15, 16.

Perform type jobs:

Unit X—6, 7, 9.
Unit XII—2.

Problem 35:

Lay a section of a 12-in. wall, bricking in a wooden door frame and forming a brick sill and segmental arch over the frame, the latter to be properly caulked.

Read paragraphs:

Unit I—13.
Unit IV—39 through 48.
Unit IX—29.
Unit X-A—26, 29.
Unit XII—20 through 27, 30.

Answer questions:

Unit I—11.
Unit IV—35, 36, 37, 38, 39, 40, 41, 42.
Unit IX—23.
Unit X—11, 13.
Unit XII—6, 8.

Perform type jobs:

Unit X—8, 10.
Unit XII—1, 3.

Problem 36:

Lay a section of a 12-in. wall leaving an opening 3 ft., 6 in. wide and 4 ft. high with a stone sill and a relieving arch, the face of the wall being supported by a steel lintel.

Read paragraphs:
Unit X-A—56.
Unit XII—37 through 39.
Answer questions:
Unit XII—13.
Perform type jobs:
Unit X—33.
Unit XII—8.

Problem 37:

Lay a plain semi-circular arch.
Read paragraphs:
Unit XII—22, 31.
Answer questions:
Unit XII—9.
Perform type jobs:
Unit XII—4.

Problem 38:

Lay a three-center rough-axed arch.
Read paragraphs:
Unit XII—21, 32, 33.
Answer questions:
Unit XII—10.
Perform type jobs:
Unit XII—5.

Problem 39:

Lay an elliptical gaged arch with rubbed brick.
Read paragraphs:
Unit XII—20, 34 through 35.
Answer questions:
Unit XII—11.
Perform type jobs:
Unit XII—6.

Problem 40:

Lay a pointed, or Gothic, arch.
Read paragraphs:
Unit XII—36.
Answer questions:
Unit XII—12.

Perform type jobs:
Unit XII—7.

Problem 41:

Construct a fireplace and chimney with an 8- by 8-in. flue lined with flue lining extending through from the floor below, the chimney rising to a height of 8 ft., the top to be capped with brick on edge capping.

Read paragraphs:
Unit XI—1 through 14.
Answer questions:
Unit XI—1, 2, 3, 4, 5, 6, 7, 8, 9.
Perform type jobs:
Unit XI—1, 2, 3, 4, 5, 6, 7.

Problem 42:

Lay an 8-in. hollow tile wall 6 ft. high for a building which is to be stuccoed, with a window opening 3 ft. wide, a terra cotta window sill, and a 3-in. tile partition meeting the outer wall 8 in. to the left of the window opening.

Read paragraphs:
Unit II—3, 4.
Unit X-A—54.
Answer questions:
Unit II—5.
Perform type jobs:
Unit II—4, 5, 6.

Problem 43:

Lay a section of a wall in "skintled" brickwork, C. B. M. A. effect No. 1 Figs. 80 and 81, using overburned brick.

Read paragraphs:
Unit V-B—1 through 6.
Answer questions:
Unit V—24.
Perform type job:
Unit V—16.

Problem 44:

Lay a section of a wall in skintled brickwork C. B M. A. effect No. 5 Figs. 84 and 85.

Read paragraphs:
Unit V-B—1 through 6.
Answer questions:
Unit V—25.
Perform type job:
Unit V—17.

Problem 45:

Lay a section of a wall in any one of the decorative patterns shown in illustration on pages 72 to 73, using brick of two colors.

Read paragraphs:

Unit V-A—22.

Unit X-A—47.

Answer questions:

Unit X—6.

Perform type jobs:

Unit X—30.

PART V

UNIT XV

TRADE TESTS

UNIT I

TYPES OF BRICK

Questions:

1. What are the standard dimensions of a brick?
2. What is common brick?
3. What is face brick?
4. How is a pressed brick made?
5. How is a molded brick made?
6. What is the difference between a soft mud and a stiff mud brick?
7. What is a glazed brick?
8. What are fire and silica brick?
9. What is a paving brick?
10. What is an impervious brick?
11. What is a special brick?
12. What is a porous brick?
13. What considerations enter into the selection of brick?

UNIT II

TILE, TERRA COTTA, AND OTHER CLAY PRODUCTS

Questions:

1. What is floor and wall tile?
2. What is hollow tile?
3. What is ornamental terra cotta?
4. What are cement blocks?
5. Is hollow tile a satisfactory base for stucco? Why?

Type Jobs:

1. Lay decorative floor and wall tile in a brick wall.
2. Back a brick wall with hollow tile.
3. Lay a terra cotta cornice.
4. Lay an 8-in. tile wall.
5. Lay a 3-in. tile partition.
6. Set a terra cotta window sill and jamb piece.

Unit III

MORTAR

Questions:

1. What is mortar?
2. What are its uses?
3. What considerations enter into the selection of mortar for a given job?
4. What is the difference between the way in which lime mortar and cement mortar sets?
5. What should be the consistency of mortar?
6. Describe a mortar bed and a mortar box.
7. What tools and equipment are used for mixing mortar?
8. Where should the mortar bed be located?
9. What is the nature of lime mortar?
10. For what purposes is lime mortar used?
11. What do we mean by slaking lump lime?
12. How should lime mortar be mixed?
13. What is meant by aging?
14. What is meant by tempering?
15. What are the advantages of hydrated lime?
16. What is the nature of cement lime mortar?
17. What are its uses?
18. What cement should be selected for mixing cement lime mortar?
19. What is lime putty?
20. How do we retemper cement lime mortar?
21. How is cement lime mortar usually proportioned?
22. How should we mix hydrated lime?
23. What is the nature of cement mortar?
24. What are its uses?
25. Why should we add lime putty?
26. Describe the characteristics of various cements.
27. How do we mix cement mortar?
28. How do we retemper cement mortar?
29. What is lump lime?
30. What is hydrated lime?
31. What is Portland cement?
32. What is natural cement?
33. What sand should be used for mixing mortar and why?
34. What tests are there for good sand?
35. How do you color mortar?
36. How may we mix mortar for cold-weather jobs?

Type Jobs:

1. Slake a batch of lump lime.
2. Mix a batch of lime mortar.

3. Stack a batch of lime mortar.
4. Temper a batch of lime mortar.
5. Mix a batch of lime mortar, using hydrated lime.
6. Make two tests for sand.
7. Color a batch of mortar.
8. Mix a batch of 1:1:6 cement lime mortar.
9. Mix a batch of 1:3 cement mortar.

Unit IV

TOOLS AND EQUIPMENT

Questions:

1. Describe the trowel.
2. What is its use?
3. How should we select a trowel?
4. What is a brick trowel?
5. What is a buttering trowel?
6. What are pointing and striking trowels?
7. What are fountain trowels?
8. What is a brick chisel, or set?
9. Describe a bricklayer's hammer.
10. What is a scutch?
11. What is a cold chisel?
12. What is a star drill?
13. Describe a jointer.
14. Describe a tool bag.
15. What is the square used for?
16. What is the use of a pocket rule?
17. Describe the two types of plumb rules.
18. What is a straightedge and what are its uses?
19. Describe the hod.
20. What are the uses of a wheelbarrow?
21. Describe the construction of a mortar board.
22. Describe the construction of a mortar box.
23. What type of screen may be used to best advantage?
24. What is a mortar hoe?
25. What type of shovel should be used?
26. What are finger protectors?
27. When should a mortar mixer be used?
28. What is the line?
29. What is a plumb bob?
30. Is there more than one size of hod? Why?
31. Describe a scaffold.
32. What are the uses of trestles?
33. What are scaffold squares?
34. What are scaffold brackets?

35. What is a putlog scaffold?
36. How are the putlogs placed on the scaffold?
37. What is meant by staying the scaffold?
38. Describe a safe method of splicing a scaffold pole.
39. What are outriggers?
40. What is a suspended scaffold?
41. What is a derrick?
42. When can a material hoist be used most efficiently?
43. How are batter boards used and how is a building laid out?

Unit V, A and B

BONDS

Questions:

1. What is bond?
2. What should be considered in selecting a bond?
3. What is a stretcher?
4. What is a header?
5. What are the uses of headers and stretchers?
6. What do we mean by keeping the perpends or keeping the end joints plumb?
7. Describe a bat and the different forms of closers, and state how they are used.
8. Make a pencil sketch of stretcher or running bond.
9. Describe the methods of tying stretcher bond to the wall.
10. Make a pencil sketch of the corner of a wall showing clipped bond.
11. When is clipped bond used?
12. Make a pencil sketch of the corner of a wall showing common, or American, bond.
13. Make a pencil sketch of the corner of a wall showing English bond.
14. Make a pencil sketch of the corner of a wall showing English cross-bond.
15. Make a sketch of the corner of a wall showing garden wall bond.
16. Make a sketch of the corner of a wall showing Dutch bond.
17. Make a sketch of the corner of a wall showing Flemish bond.
18. What is the difference between single and double Flemish bond?
19. Make a sketch of a portion of the face of a wall, showing Flemish spiral, or continuous, bond.
20. Make a sketch showing the herringbone pattern.
21. Make a sketch showing the diagonal pattern.
22. Illustrate block, or diaper, bond.
23. What is an insert?
24. What is skintled brickwork?
25. To what class of building are these effects best adapted?

Type Jobs:

1. Lay a stretcher or running bond with metal ties (8-in. wall).
2. Lay a clipped bond (8-in. wall).
3. Lay a corner in common or American bond (8-in. wall).
4. Lay a corner in English bond (8-in. wall).
5. Lay a corner in English cross-bond (8-in. wall).
6. Lay a corner in garden wall bond (8-in. wall).
7. Lay a corner in Dutch bond (8-in. wall).
8. Lay a corner in double Flemish bond (12-in. wall).
9. Lay a wall in single Flemish bond (12-in. wall).
10. Lay a wall in double-stretcher Flemish bond (12-in. wall).
11. Lay a section of a curved wall with a spiral bond (8-in. wall).
12. Lay a section of a garden walk in herringbone pattern.
13. Lay a section of a garden walk in diagonal pattern.
14. Lay a section of block or diaper pattern.
15. Lay an insert in a wall.
16. Lay a section of a wall, using effect No. 1, Fig. 81 skintled brickwork using overburned brick.
17. Lay a section of a wall, using effect No. 5, Fig. 85, in skintled brickwork.

Unit VI

ROWLOCKS, SOLDIER COURSES, AND PANELS

Questions:

1. What is a rowlock?
2. What is a rowlock header?
3. What is a rowlock stretcher?
4. What is a soldier course?
5. Make a sketch of a decorative panel.
6. What is a bonded course?
7. Make a sketch of a saw-tooth course.
8. Make a sketch of a dentil course.

Type Jobs:

1. Lay a course of rowlock headers.
2. Lay a course of rowlock stretchers.
3. Lay a soldier course.
4. Lay a panel.
5. Lay a 12-in. bonded course.
6. Lay a saw-tooth course.
7. Lay a dentil course.

Unit VII

JOINTING

Questions:

1. What is jointing?
2. What should be considered in selecting a joint?
3. What width of joint should be selected?
4. What is a struck joint?
5. What is a weathered joint?
6. What is a plain- or rough-cut joint.
7. What is a flush-cut joint?
8. What is a raked joint?
9. What is a stripped joint?
10. Describe a tooled joint.
11. Describe a beaded joint.

Type Jobs:

1. Form a struck joint.
2. Form a weather joint.
3. Form a plain- or rough-cut joint.
4. Form a flush-cut joint.
5. Form a raked joint.
6. Form a stripped joint.
7. Form a V joint with a jointing tool.
8. Form a beaded joint.

Unit VIII

POINTING

Questions:

1. What is pointing?
2. What is tuck pointing?
3. How should an existing wall be pointed?

Type Jobs:

1. Tuck point a section of wall.
2. Point a section of an existing wall.

Unit IX

BRICKLAYING

Questions:

1. What should the apprentice bricklayer consider in studying th various methods of laying brick?
2. How should the mortar board be used?
3. How should the trowel be held?
4. What should be considered in picking up mortar?
5. How should mortar be spread?

6. What should be considered in cutting off mortar?
7. When and why should brick be wet?
8. What should be considered in picking up brick?
9. What should be considered in laying brick?
10. Describe the pick and dip method of laying brick.
11. Describe the stringing mortar method of laying brick.
12. What is a shoved joint?
13. What is a grouted joint?
14. What is a slushed joint?
15. What is an open joint?
16. What is a dry joint?
17. What is a filled joint?
18. What do we mean by roll?
19. What should be considered in setting the line?
20. What do we mean by laying of the line?
21. What do we mean by crowding the line?
22. What do we mean by raising a corner lead?
23. How should a story pole be used?
24. What should the man working at the corner take into consideration in laying his brick?
25. How important is sighting?
26. How do we plumb a corner?
27. Describe methods of cutting and clipping brick.
28. Why should the wall be covered after quitting?
29. What precautions should be taken to keep the wall clean?
30. How is fire brick laid?
31. How is impervious brick laid?
32. Why is silica brick laid dry?

Type Jobs:

1. Prepare a mortar board and stack mortar upon it.
2. Wet down brick.
3. Set the line.
4. Lay brick by stringing mortar method.
5. Lay brick by pick and dip method.
6. Form a shoved joint.
7. Form a grouted joint.
8. Form a slushed joint.
9. Form an open joint.
10. Lay a face tier with correct roll.
11. Raise a corner lead.
12. Sight the wall for plumbness.
13. Plumb a corner.
14. Cut a bat and a queen closer.
15. Cover the wall.
16. Keep the wall clean while under construction.

17. Lay fire brick with fire clay.
18. Lay silica brick dry.
19. Lay impervious brick in a wall.
20. Lay a dry-joint inserting lath.

Unit X, A and B

MISCELLANEOUS CONSTRUCTION

Questions:

1. What is meant by toothing?
2. What is meant by racking?
3. What is meant by blocking?
4. What are nailing blocks and how are they used?
5. What is a panel?
6. How may decorative effects be obtained by the use of brick?
7. What is a belt string or sailing course?
8. Describe methods of laying and backing up a corbel, stating why it should be well tied down.
9. Describe methods of laying a window sill.
10. What is a jamb?
11. How should a door sill be laid?
12. What methods are used for setting a door or window frame?
13. What do we mean by caulking frames?
14. What are chases?
15. Make a sketch of methods of laying a brick wall at angles other than 90 deg.
16. What should be considered in laying a brick wall against the brick wall of another building?
17. Describe methods of laying pavements.
18. How would you build a garden wall?
19. Describe methods of laying steps.
20. How would you lay a gate post?
21. What is a cavity or vaulted wall?
22. Describe the Ideal wall.
23. What is a veneered wall?
24. What do you mean by nogging?
25. What must be considered in laying a footing?
26. What do we mean by underpinning?
27. What is a pier?
28. What is a pilaster?
29. How are joists supported?
30. What are anchors and how are they installed?
31. How may we moisture proof a wall?
32. What is stucco?
33. Why are bricks suitable for septic tanks, manholes, and sewers?
34. Describe methods of laying fire stops.

35. What are party, fire, and division walls?
36. Describe methods of laying a brick fireproof floor.
37. How may brick be used to enclose steel columns?
38. For fireproof construction, why are elevator and stairway inclosures extended above the roof of the building?
39. When may brick be used for interior finish?
40. How should the thickness of a wall be determined?
41. How may we add to the thickness of a wall?
42. What should be considered in laying second-hand brick?
43. What methods should be used in filling a putlog hole?
44. What methods should be used in joining new work to toothing?

Type Jobs:

1. Lay a section of a wall, toothing the ends.
2. Lay a section of a wall, racking the ends.
3. Lay a section of a wall, blocking the ends.
4. Lay a section of a wall with nailing blocks for a base board.
5. Corbel out a wall.
6 Lay a brick window sill.
7. Lay a jamb.
8. Lay a door sill.
9. Set a door or a window frame.
10. Caulk a door or a window frame.
11. Lay a wall with a pipe chase.
12. Lay a corner at an obtuse external angle.
13. Lay a garden wall with a supporting angle.
14. Lay a flight of steps.
15. Lay a gate post.
16. Lay a corner of a 12-in. Ideal all-rolok wall.
17. Veneer a section of a frame dwelling.
18. Lay a footing.
19. Lay a solid pier.
20. Lay a hollow pier.
21. Lay a pilaster.
22. Lay a section of a wall, changing from a 12-in. to an 8-in. wall and supporting joists, the joists to be fire-cut and anchored with a fire stop laid between them.
23. Damp proof a section of a basement wall.
24. Lay a section of a manhole.
25. Lay a section of a fireproof floor.
26. Inclose a steel column in brick.
27. Add to the thickness of an existing wall.
28. Fill a putlog hole.
29. Join new work to toothing.
30. Produce a decorative effect by the use of brick of different colors.
31. Lay a belt, string, or sailing course.

32. Fill in between the studs of a frame dwelling by nogging.
33. Lay a stone window sill.

Unit XI

CHIMNEYS AND FIREPLACES

Questions:

1. What factors should be taken into consideration in laying a chimney?
2. What methods should be used to insure a good draft?
3. What is the best method of cutting flue linings?
4. How should a chimney be supported?
5. What are good mortar mixtures for chimneys and fireplaces?
6. What methods are used in laying large stacks for industrial purposes?
7. What is a fireplace?
8. Name the parts of a fireplace.
9. Describe methods of laying a fireplace.

Type Jobs:

1. Cut a flue lining.
2. Lay a section of a chimney, inclosing two flue linings.
3. Lay the back and sides of a fireplace.
4. Lay a fireplace throat, inserting a metal damper.
5. Lay a fireplace arch.
6. Lay a fireplace mantel.
7. Lay a fireplace hearth supported on a trimmer.

Unit XII

ARCHES AND LINTELS

Questions:

1. What is an arch?
2. What is a lintel?
3. What are the uses of arches and lintels?
4. Make a sketch of an arch, one end resting upon a pier, the other end resting upon a wall abutment, and name all of the parts of the arch.
5. What methods are used in laying out an arch?
6. Lay out a gaged segmental arch of alternate headers and stretchers to scale, using a compass and rule.
7. Make a pencil sketch of a jack, flat, or camber arch, showing the three methods of determining the cut of the skewback.
8. Make a pencil sketch of a segmental arch constructed of rowlock headers.
9. Make a pencil sketch of a semi-circular, or Roman, arch.

10. Lay out a three-center arch.
11. Make a sketch of an elliptical arch.
12. Make a sketch of a pointed arch.
13. Make a sketch of a supporting or relieving arch.
14. Why are steel lintels used?
15. What methods are used in constructing an arch?
16. Give reasons for the selection of arches and lintels for various types of jobs.

Type Jobs:

1. Lay out a segmental arch, full size, and construct the centering for it.
2. Lay a plain jack, flat, or camber arch.
3. Lay a segmental arch.
4. Construct a center and lay a semi-circular, or Roman, arch.
5. Lay a three-center arch.
6. Lay an elliptical arch.
7. Lay a pointed arch.
8. Lay a supporting arch, using a steel lintel to support the face of the wall (12-in. wall).

Unit XIII

EFFLORESCENCE

Questions:

1. What is efflorescence?
2. Name some of its causes.
3. What remedies may be used?

Type Jobs:

1. Clean a wall upon which efflorescence has appeared.

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